SPECIAL AUDIO FEATURE ISSUE

RADIO & TELEVISION NEWS

NOVEMBER
1954
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IN THIS ISSUE

CHOOSING YOUR HI-FI LOUDSPEAKER

THE PRACTICAL SWITCHLESS INTERCOM

THE POOR MAN'S "3D" CONVERTER

SERVICING RECORD-CHANGERS

FOUR-CHANNEL AUDIO MIXER

SERVICING HI-FI AMPLIFIERS

JUNK BOX "SENDING IRON"

NEW STANDARDS FOR TV ANTENNAS

FUNDAMENTALS OF COLOR TV

ALL-PURPOSE ENCLOSURE FOR 12" SPEAKER
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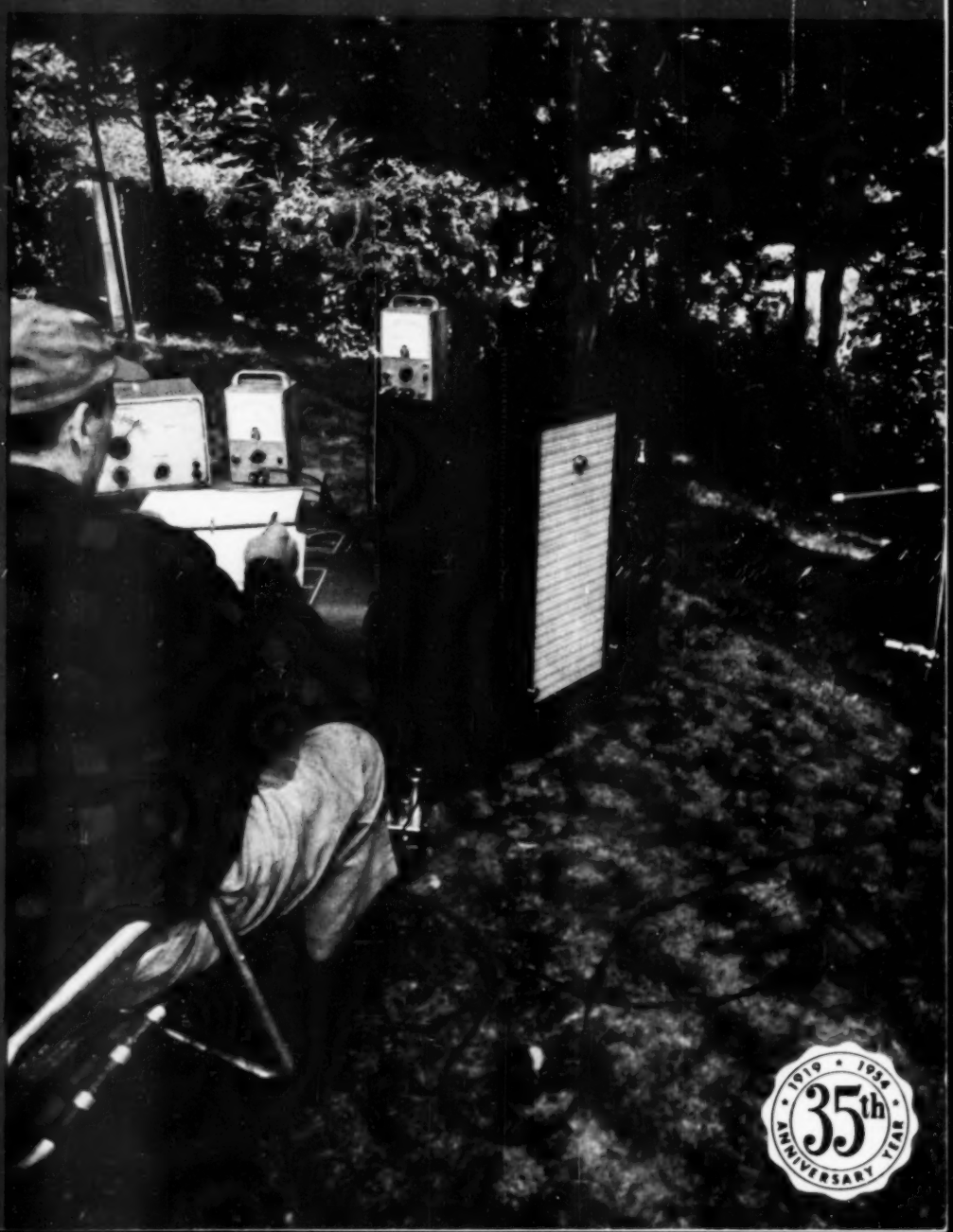

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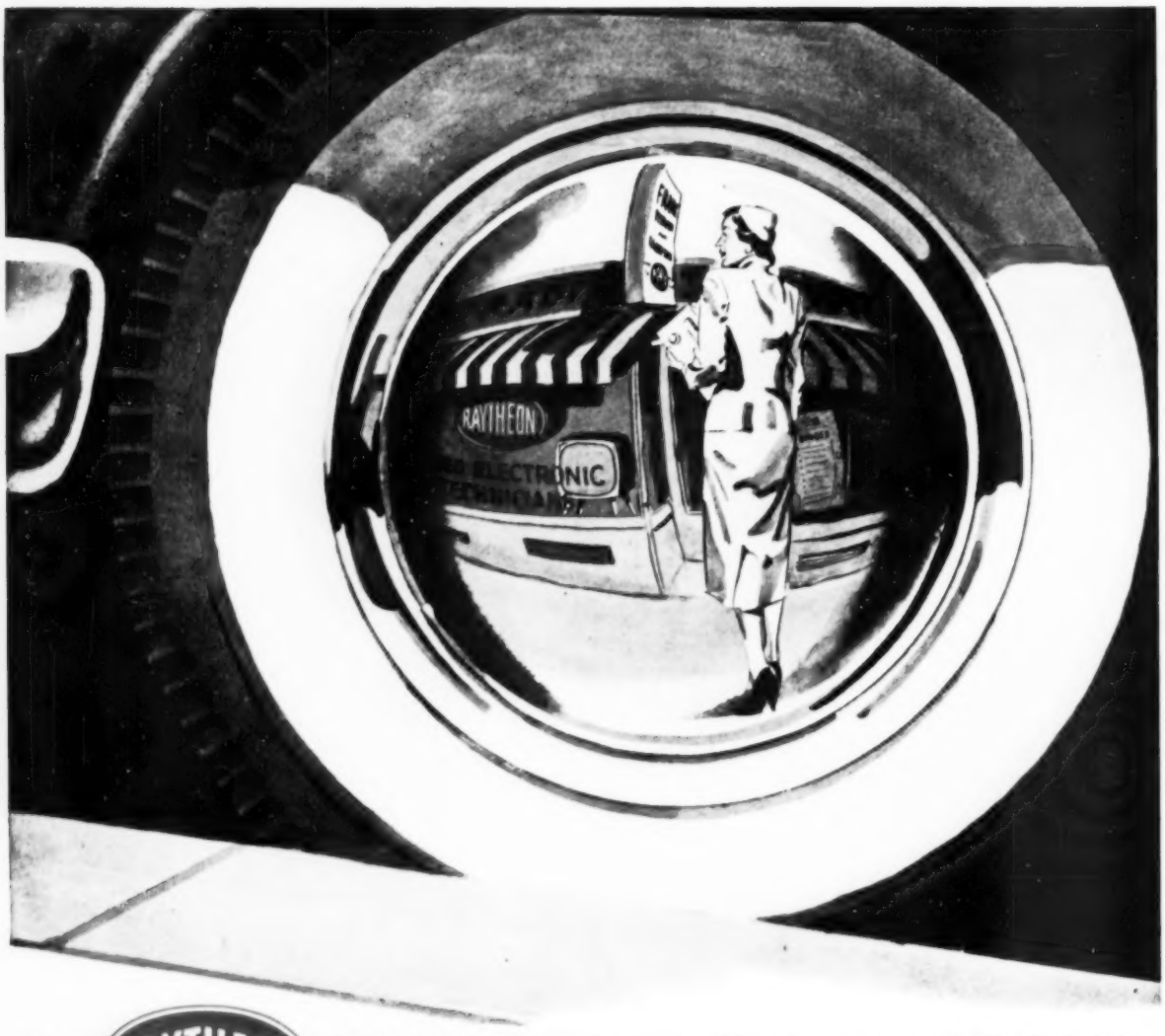

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COVER PHOTO: Free-field response measurements being made on the "Fold-a-flex 12" described in this issue. The E-V 655 and Shure 98-99 calibrated microphones connect to a Heath AV-2 a.c. vacuum-tube voltmeter. (Ektachrome by Jay Seymour)

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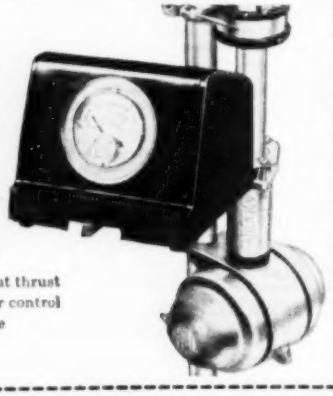

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For the RECORD.

BY THE EDITOR

NOTED WITH INTEREST—THE HI-FI PARADE

INTEREST in high-fidelity has reached a new peak as we enter the "audio season." Equipment and components have grown steadily better. New circuits have enhanced the output characteristics of audio amplifiers. Loudspeakers, especially for the mid-ranges, have been redesigned and greatly improved. Electrostatic reproducers are about ready to enjoy widespread acceptance and improved FM tuners are now available from many manufacturers.

Innovations in the design of quality tape recorders, together with the new "long play" tapes, provide better performance at less cost to the audiophile. Pre-recorded tapes are, once more, available over the counter. These are costly but they can provide a source of noise-free enjoyment for the serious music lover. Owners of quality recorders can in the long run build a fine hi-fi tape library at low cost by "rolling their own." Off-the-air tape recording of live FM (or new LP's) is especially well suited as source material. Unlike phono records a tape must be recorded and played back on the same machine for best possible reproduction. Intermixing of recorded tapes and machines is not good practice and can't be until standards are compatible.

We've had the opportunity in recent weeks to test and study several new products and circuits of interest to the audiophile. Here's a capsule preview of a few. The new *Berlant* broadcast recorder avoids all troublesome belts, pulleys, and idlers. An entirely new type drive permits the operator to "shuttle" the tape to locate any point on a tape. We liked the ease of loading and found excellent timing accuracy. This unit is the simplest to maintain or service that we have used. It is "pro" in every respect.

Standard 10½" reels, loaded with the new "long-play" plastic tapes were found ideally suited to the recording of complete symphonies (at 15 i.p.s.) without interruption using full-track on the recorder. The new *Ampex* 600 (using 7" reels) is another quality recorder in the middle price class. It uses but one speed (7½ i.p.s.) and employs a single synchronous motor. We were quite impressed with the performance of this new portable when it was demonstrated to us on the West Coast a few weeks ago.

Another development worthy of comment is an "Audi-Balance" control on *Newcomb's* "Classic Series" of amplifiers which permits compensation to maintain balance of the output tubes to offset the effects of aging. Loudspeaker manufacturers, out movie-land way, continue to supply the listener with well-designed reproducers. We've used several in conducting our development of the "Fold-a-flex" enclosure described in this issue. Outstanding were the *Stephens* 206AX coaxial, the *Jim Lansing* (2-way) comprising the D-1002 system with 1200-cycle crossover, and the *Altec* 602-A coaxial. All of these were tested in the "Fold-a-flex" enclosure (for 15" speakers) described last November.

The first of several audio shows, this one in Chicago, gave us an opportunity to hear some of the Mid-West's latest contributions to high-fidelity. First equipment to catch our fancy was the new line of amplifiers by *Electro-Voice* featuring the *Wiggins* "Circlotron" circuit for controlling the damping factor presented to a loudspeaker. A very handsome preamp and remote has been added to the new *E-V* component line. *Radio Craftsmen's* C-1000 FM-AM tuner contains complete facilities for preamp-equalizing and is beautifully styled. This firm is one of the pioneers in hi-fi gear. *Regency* now has, in addition to a very high priced line, a new HF150 combined preamp and amplifier in the competitively priced field. A good clean design, too. *Jensen*, another of the pioneers in hi-fi, has a wide choice of components designed for the audiophile. Their G610 is still a favorite of many serious music critics. And, have you heard *University's* new Model 315 triaxial? If you like high volume, high-fidelity with excellent frequency response better take a listen to this heavy-duty reproducer that can handle up to 50 watts.

It's a bit early to make any comment on the maze of new audio equipment that will be seen at the New York or Boston shows. Much of the equipment to be displayed is still "under wraps" as this is being written. But, we have been able to see, hear, and, in some cases, test some of the newer products. *National* provided their new "Horizon" line for a series of hi-fi experiments—especially for recording binaural AM-FM programs with the "Criterion" tuner. This well-designed unit has separate r.f. and detector circuits that provide independent reception of both AM and FM from stations, such as WQXR in New

(*Continued on page* 124)

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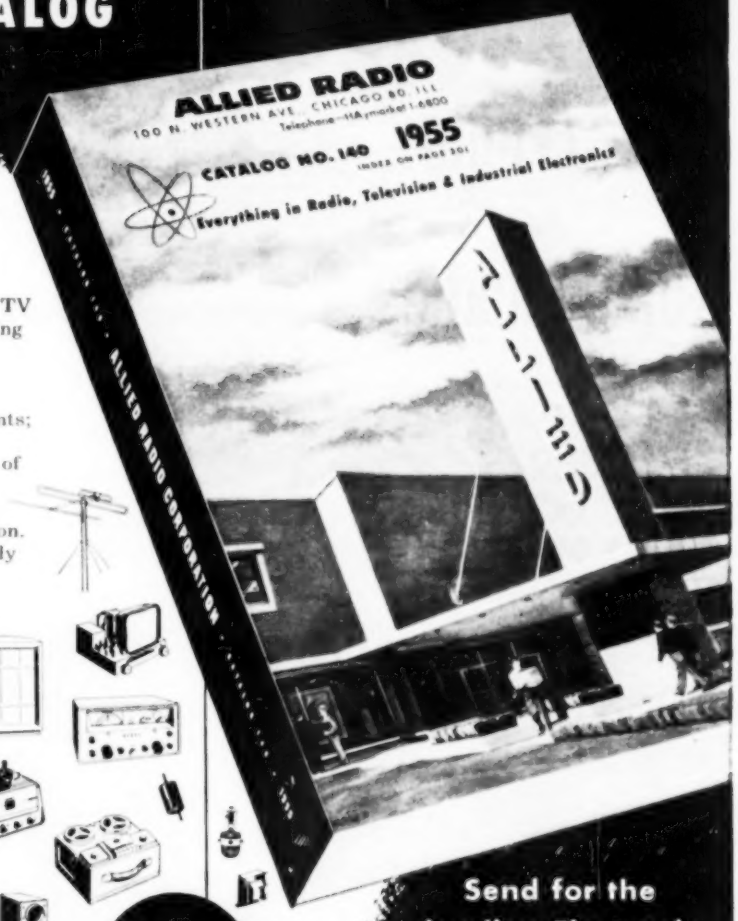
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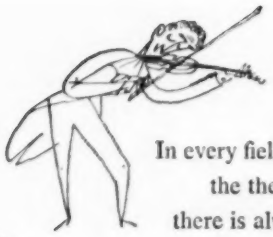

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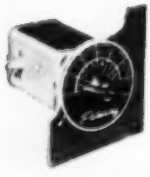

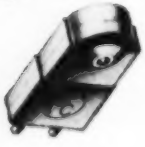

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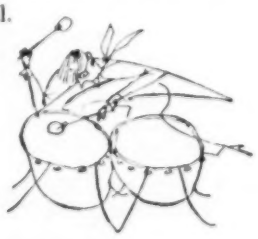

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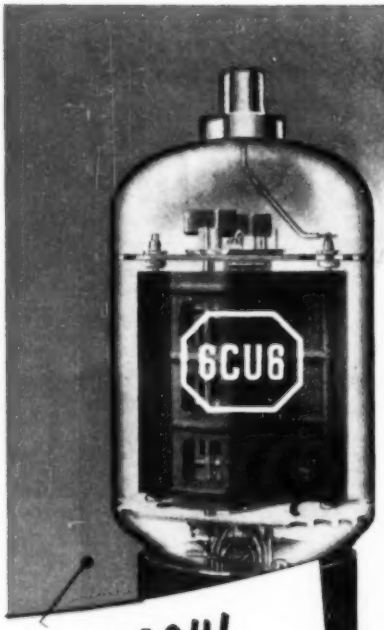

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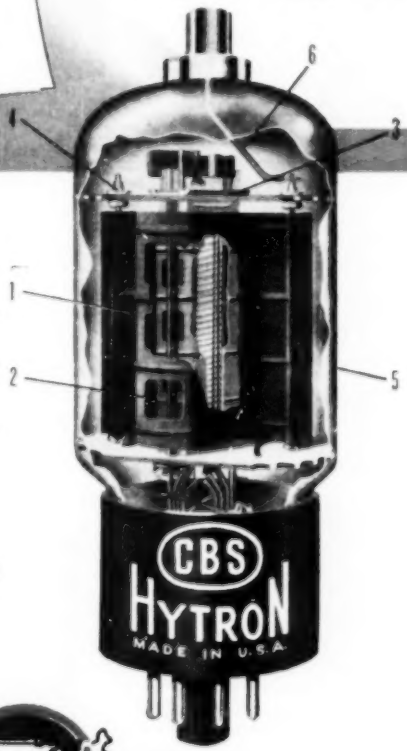
The 6BQ6GT is a good tube. (Heck, CBS-Hytron originated it.) But, it was designed for 10- and 12-inch TV sets. Today it carries the load in 21-inch sets. Furthermore, it must combat the accumulated dissipation caused by: 1. Line-voltage variations. 2. Faulty receiver adjustments. 3. Shifting values of components due to age and overload. Result: The 6BQ6GT is often operated above maximum ratings.

Obviously, a brand-new design . . . not just an improved 6BQ6GT . . . was needed. The husky CBS-Hytron 6CU6 (See Mechanical Features) is the answer: a premium-performance tube *at no extra cost*. CTS-Rated, it offers generous safety margins for plate dissipation . . . high-voltage insulation . . . and high-line protection. Note also the bar graph showing much larger plate and envelope areas of CBS-Hytron 6CU6.

In the 6CU6 . . . another CBS-Hytron first . . . high voltage and heat meet their match. You forget run-away plate current, high-voltage arc-overs, and shrinking TV pictures. You gain by longer life . . . minimized service . . . happier customers. Try the CBS-Hytron 6CU6 today.

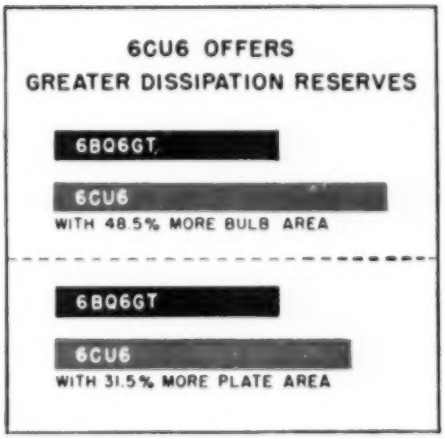
*Rated for Continuous Television Service



MECHANICAL FEATURES OF 6CU6

1. Heavier-gauge plate with large radiating fins.
2. Vents in beam plates and plate aligned for maximum radiation of heat from grids.
3. Anti-arc rings for uniform distribution of electrostatic field.
4. Anti-arc mica eyelets.
5. T-12 transmitting-type bulb.
6. Plate connection "hard-soldered" and positioned to reduce heat conduction and arcing.

6CU6 OFFERS GREATER DISSIPATION RESERVES



CBS HYTRON

Manufacturers of Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Massachusetts

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the finest in High Fidelity!

Complete 4-way Speaker System

FOR LESS THAN $300.00

*See Model 105-106 below

STEP 1

Model 105 Package of Georgian Driver Components

This gives the music lover the driving components to start a **Georgian** 4-way system. Can readily be used for converting existing Klipsch type speaker systems to a **Georgian** 4-way. Includes E-V 15WK LF Driver, 848HF Coaxial Mid-Range Unit, T35 VHF Driver, X336 Crossover Network, AT37 Level Controls and 8574 Cable Harness. Also includes complete instructions for constructing "K" bass section and outer furniture housing for **Georgian.**

List, $342.00. **Audiophile Net, $205.20**

STEP 2

Model 106 Klipsch "K" Type Basic Low-Frequency Driver Horn

Add this corner folded horn with back deflecting board and corner spacer for bass section to augment bass reproduction. Designed for E-V 15WK 15" low-frequency driver unit. Painted with flat matte black prime coat, in order not to show through grille cloth. Can be painted by user in other colors, but will not take furniture finish. Size: 38½" high x 32¼" wide x 22¾" deep.

List, $150.00. **Audiophile Net, $90.00**

STEPS 1 and 2

Model 105-106 Complete 4-way Reproducer Kit—Ready to Assemble and Operate

Consists of all parts of the **Georgian** system except the outer decorative housing. Includes Model 105 Driver Components and Model 106 "K" type corner folded horn. Ideal for building in. Also used as utility high fidelity monitoring speaker system for commercial purposes and for sound reinforcement in auditoriums. Plans supplied for home construction of outer decorative furniture housing. Can be assembled easily, quickly with ordinary tools. No cutting or fitting required.

List, $492.00. **Audiophile Net, $295.20**

Now Get GEORGIAN 4-Way Performance...Economically...Step-By-Step

Now for the first time by easy stages, the quality-minded, budget-limited hi-fi enthusiast can own and enjoy the thrilling 4-way performance of the magnificent E-V GEORGIAN loudspeaker system! Think of it! For only $295.20 Audiophile Net, you have the complete GEORGIAN 4-WAY SYSTEM, less the outer decorative cabinet which you can add at any time!

STEP 3 Model 107 Georgian Outer Decorative Furniture Housing Only—in lustrous hand-rubbed finish

Mahogany. List, $333.00. **Audiophile Net, $199.80**
Blonde. List, $366.33. **Audiophile Net, $219.80**

Model 109 Georgian Cabinet Combination Consists of Models 106 and 107.

Mahogany. List, $483.00. **Audiophile Net, $289.80**
Blonde. List, $516.33. **Audiophile Net, $309.80**

THE MAGNIFICENT *Georgian*

Write for Bulletin No. 199

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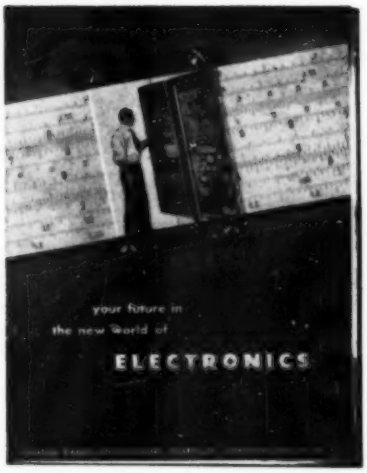
Electro-Voice

ELECTRO-VOICE, INC. • BUCHANAN, MICHIGAN



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"Luck," some may say.

"Contacts," others may suggest.

But in your heart, you will know the answer: "Training." And it all may have started the moment you filled out a coupon requesting a copy of a free booklet named "Your Future in the New World of Electronics." From this data you get knowledge of where you stand in Electronics. Tremendous expansion leaves this gigantic industry pleading for trained men. Top manufacturers sold billions of dollars worth of electronic merchandise in 1953. By 1960, the radio-electronics industry should do no less than 10 billion dollars per year, not counting military orders.

Today there are over 97,000 radio-equipped police cars; an even larger number of taxis are radio equipped (at least 87,000); 32,000 civilian planes have radio; 35,000 American ships have radio.

Today there are over 120,000,000 radios in use. There are 28,000,000 TV sets and 381 TV stations in operation. Color TV is coming into its own. Countless positions must be filled—in development, research, design, production, testing and inspection, manufacture, broadcasting, telecasting and servicing. To fill these posts, trained men are needed—men who somewhere along the line take time to improve their knowledge, their skills. Men who, today, perhaps, take two minutes to send for a booklet.

"Your Future in the New World of Electronics" shows you how CREI Home Study leads the way to greater earnings through the inviting opportunities described above.

However, CREI does not promise you a "snap." With an accredited technical school such as this, you must *study* to convert your ambition into technical knowledge you can sell in the fabulous Electronics market.

Since its founding in 1927, CREI has provided thousands of professional radio men with technical educations. During World War II CREI trained thousands for the Armed Services. Leading firms choose CREI courses for group training in electronics, at company expense, among them United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Sears, Roebuck and Co., Bendix Products Division, All-American Cables and Radio, Inc., and RCA Victor Division.

CREI courses are prepared by recognized experts, in a practical, easily understood manner. You get the benefit of time-tested materials, under the personal supervision of a CREI Staff Instructor, who *knows* and *teaches* you what industry wants. This is accomplished on your own time, during hours selected by you, and controlled by your own will power. This complete training is the reason that graduates find their CREI diplomas keys-to-success in Radio, TV and Electronics. CREI alumni hold top positions in America's leading firms. At your service is the CREI Placement Bureau, which finds positions for advanced students and graduates. Although CREI does not guarantee jobs, requests for personnel far exceed current supply.

Now is the time of decision for you. Luck will not propel you forward unless it finds you trained. Contacts won't budge you an inch unless you have the skill to back them up. The answer is: Technical Training . . . and willingness to learn. Together they will bring you increased earnings in this new Age of Electronics. Fill out the coupon shown below and mail it now. We'll promptly send you your free copy of "Your Future in the New World of Electronics." The rest—your future—is up to you.

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NEW PATENTED RADAR ANTENNA

53 CLAIMS GRANTED IN 5 U. S. PATENTS — #2,585,670 — #2,609,503 — #2,625,655 — #2,644,091 — #2,661,423

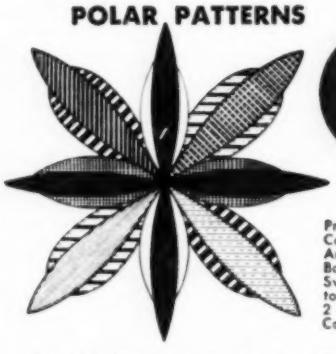
OPENS NEW HORIZONS TO TV VIEWERS

These are the reasons why the "Riviera" is by far the most powerful VHF antenna on the market today!

1. Utilizes 16 elements 60" long, ½" diameter.
2. Utilizes a specially designed, extra low loss four conductor air-dielectric POLYMICALENE transmission line which has up to 50% less loss when wet than the finest conventional transmission lines.
3. The "Riviera" encompasses an electro-magnetic capture volume of well over 650 cubic feet, many times more than conventional antennas.
4. The antenna works on the revolutionary principle that the approaching wave front is elliptically rather than horizontally polarized.
5. The new specially designed 9 position electronic orientation switch, aside from changing directivity, maintains a consistently better impedance match over the entire UHF-VHF spectrum.
6. The above features combine to give the "Riviera" antenna greater usable gain at the TV set antenna terminals than the best of any competitive antennas using rotor motors.

This new wonder antenna, called the "Riviera", is already making history. Beyond any question of a doubt, and on an *unconditional money back guarantee*, it will positively outperform in the field under actual installation conditions, any and all competitive antennas on the VHF channels, with or without rotor motors.

POLAR PATTERNS



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Price includes: Complete Stacked Array • Stacking Bars • 9 Position Switch • Switch-to-set Coupler • 2 Stand-offs, 7½" • Complete instructions

The polar directivity response patterns show the major lobes of the "Riviera" antenna on VHF. It shows the fullness of coverage in all directions of this remarkable, patented antenna as it is turned through each of the nine switch positions. Each degree of shading constitutes a different switch position. This excellent directivity response, which can be switched at will, plus the extremely high gains, clearly indicate why the Riviera is such a superior performer.

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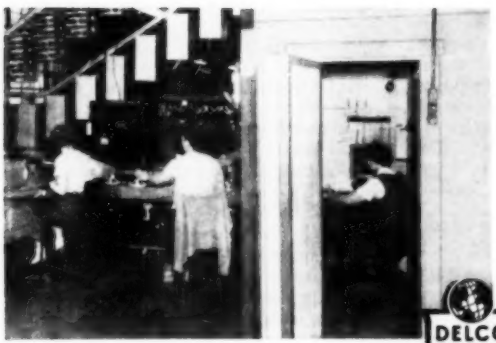
100 MILES VHF • 60 MILES UHF

Speaking of Speakers...

DELCO RADIO CAREFULLY CONTROLS THE MANUFACTURING OF ITS SPEAKERS TO ASSURE HIGHEST POSSIBLE QUALITY



In the audio test booth, the speaker is checked for its ability to deliver good listening. In the background you can see a small section of the speaker production line.

High quality in the final product can be had only through rigid quality control. Take speakers, for example. Speaker baskets are formed in our stamping department. Special machines wind the voice coils. On the assembly line the cones are secured to the voice coils and then assembled with the basket. All along the line inspectors have been checking and rechecking. Then, the speaker is magnetized and goes into a specially designed sound booth for a final check.

This continuing quality control is one important reason why Delco Radio replacement parts assure customer satisfaction. Made by the world's largest manufacturer of auto radios, they are available from your UMS Delco Electronic Parts Distributor.

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REVOLUTIONARY!
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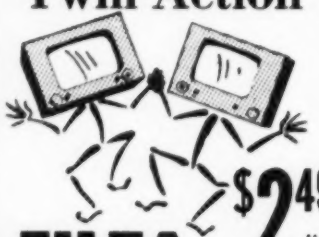

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SUPEREX brings you greater value . . . more for your money by combining 2 necessary items for all homes with two TV sets. 2-set coupler eliminates second antenna . . . built-in Hi-pass filter insures perfect reception for BOTH sets.
For the right combination to greater profits, stock up on modern Superex Filta-Coupler TODAY!
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Spot Radio News

*** Presenting latest information on the Radio Industry.**

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE SWEEPING BRICKER SENATORIAL TV investigation involving the very-highs and the ultra-highs, as well as network operations, which is expected to last many months, will be one of the most torrid probes ever conducted in Washington. It'll sizzle, officialdom and industry experts say, from the moment the briefs are filed and witnesses start testifying. Tempers will flare up, everyone admits, as soon as claims and counter-claims rattle the hearing rooms.

And the fiery sessions will not only be due to the basic considerations, and the strong opposing views of former FCC Commissioner Robert Jones, who has been named to head the inquiry, and Harry Plotkin, former FCC assistant general counsel, who will represent the Democratic minority of the Senate Interstate and Foreign Commerce Committee, but to the fringe studies that might be made on issues such as industry licensing among set and transmitter makers. The latter was a pet project of the former Commissioner when he served on the FCC, and was pigeon-holed when it was learned that the Commission had no jurisdiction over such matters. Months later, the delicate matter found itself in the hands of the Department of Justice, as a possible anti-trust action, but the move to proceed was shuttled about and finally dropped.

At this writing, it appears as if the investigators, aided by Nicholas Zapple, serving as a communications expert, will collect volumes of information, and then prepare a comprehensive report, with recommendations, for the full committee which will meet in January, when Congress returns to Washington.

THE ULTRA-HIGH SATELLITE DECISION, issued, according to the Commission, to help u.h.f. stations expand their coverage through slave stations, so that u.h.f. might nearly equal v.h.f. coverage, has not met with the wholehearted approval envisioned. Instead, a growing number of critics have appeared, particularly among associations. A statement issued by the UHF TV Association, headed by Lou Poller, who operates WCAN-TV in Milwaukee (channel 25), called the FCC move one which endangers expansion. "Under the guise of the authorization of new u.h.f. stations, it appears," said the association, "that the Commission now proposes that an existing metropolitan station may consume from one to four or more u.h.f. frequencies in one or more market areas to offer only one program through satellites . . . There is no limitation stated as to the nature of the proposed satellite facilities, except that they would be on a different frequency than the parent station."

The effects of the proposal were also the subject of a critical expression from the association's general counsel. In his opinion, it is possible that . . . "key frequencies available for elimination of intermixture will be consumed without material public benefit."

In addition, he continued, merchants . . . "in cities adjoining metropolitan centers will be deprived of economical local advertising time in which to develop their businesses, and independent u.h.f. stations now relatively free of interference will be choked by major network outlets extended through so-called satellites."

Association members were asked to supply engineering and economic data that could be forwarded to the Commission to urge revocation of the new policy.

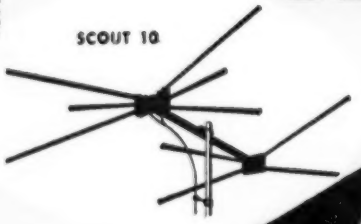
A FASCINATING ARRAY of new electronic wonders has been channeled to the military and home fronts during the past weeks.

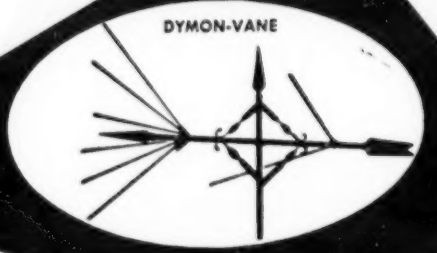
At the Griffiss Air Force Base, New York, the Air Research and Development Command has installed a *megawatt klystron* for radar use. Eight feet tall, the giant tube produces 4,000,000 peak watts of power; more than 250 times that developed in the radar that beamed pulses to the moon and back in '46.

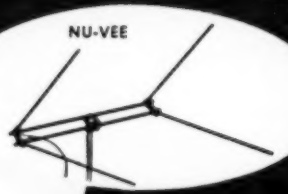
The klystron works on principles entirely different from those of the standard vacuum tube. An electron gun in the base of the tube shoots a stream of electrons through the vacuum of three hollow copper doughnuts called rhumbatrons; so named because of the rhythmic motion of electrons within these cavities. Power output of the tube depends on the number of electrons that can be forced through the holes in the rhumbatrons. The quantity of electrons in the stream can be increased up to a certain amount. Beyond this point a barrier is encoun-

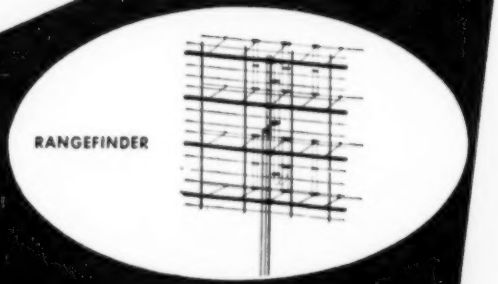
WARD Antenna Rama

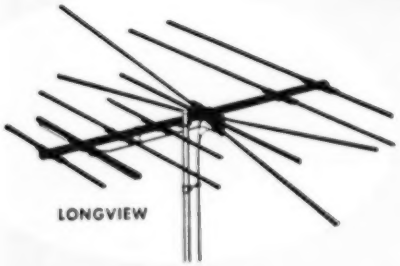
. . . means a complete merchandising and profit building program for TV antenna dealers . . . antennas designed to meet any installation requirement . . . in every price range . . . smartly styled . . . precision engineered . . . and backed by dynamic advertising and merchandising . . . all designed to make WARD your most profitable line!

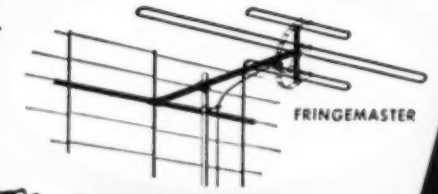












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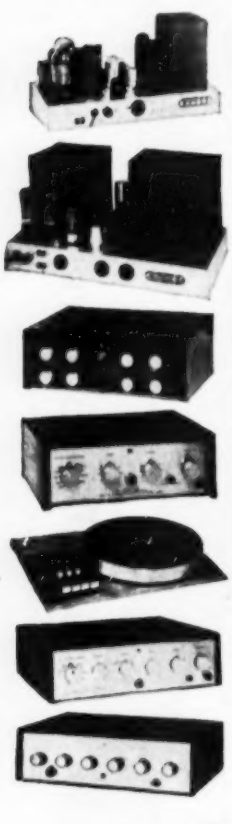
exclusive DYNAURAL noise suppressors

FM Tuner with DYNAURAL inter-station noise suppressor.

The 310 FM Broadcast Monitor Tuner has wide-band detector, full 150 kc IF pass-bands, and 3 stages of limiting allowing full advantage to be taken of high (2-microvolt) sensitivity, and giving quiet, distortionless reception of the even weakest signals. Adjustable DYNAURAL inter-station noise suppressor eliminates noise between stations. Drift-free, non-critical tuning sweeps through entire FM band with one motion.



The 232-A Laboratory Power Amplifier offers power ample for all but the very most complex systems. Outstandingly listenable, its specifications include 32 watt output, 12—80,000 cps flat frequency response, distortion less than 0.1% at full output, and noise and hum down by more than 85 db. Most practical choice and best buy among power amplifiers.

The 265-A Laboratory Power Amplifier is the best we are able to make. Its 65 watt output is more than enough for any application, and its unique, new adjustable "snubber circuit" provides maximum speaker protection even at full music output. Variable damping control permits exact speaker matching. An expensive amplifier for the perfectionist.

The 121-A DYNAURAL Equalizer-Preamplifier is the most versatile, complete control-compensation unit ever offered. It includes the patented DYNAURAL dynamic noise suppressor which virtually eliminates record scratch and rumble. Continuously variable turnover and roll-off equalization to compensate for any record — past, present, or future. Beautifully styled and self-powered.

The 120-CP Equalizer-Preamplifier is a beautiful "little jewel". Compact and self-powered, it offers exact professional control but with greater simplicity, convenience and economy than offered by the 121-A above. Like the 121 it includes hand-tooled, heavy leather case and machined anodized aluminum knobs for outstanding styling.

The 710-A Stroboscopic Broadcast Turntable features torsional and dual-stage mechanical filtering which bring motor rumble to more than 60 db down and wow to less than 0.1% while still permitting ± 5% speed and pitch adjustment. Beautifully styled and with built-in neon stroboscope, the 710-A provides unique convenient push-button selection of 33⅓, 45 and 78 rpm speeds, regardless of line voltage.

The 210-C DYNAURAL Laboratory Amplifier includes the best, most practical features developed by H. H. Scott, Inc. and at a "best buy" price. DYNAURAL noise suppressor, record distortion filter, eight equalization curves, input selector and tape recording and monitoring provisions make it *the* outstanding combination of features, performance and price.

The 99-A Transcription Amplifier offers control and compensation versatility matched by few amplifiers at *any* price. A complete equalizer-preamp and 12 watt power amp, the 99 audibly outperforms much more expensive units. The best buy and outstanding performer in the under-$100 price field by actual listening comparisons.

Professional sound equipment by H. H. Scott, Inc. is designed for the discriminating music lover who recognizes and appreciates those extra features and engineering refinements separating the superb from the merely good. The medals, awards and ratings earned throughout years of pioneering in technical and styling trends are but an indication of the unique "listenability" of H. H. Scott equipment.

H. H. SCOTT inc.

"FREE BOOKLET"

385 PUTNAM AVENUE, CAMBRIDGE 39, MASS.

tered that causes the electrons to be thrown out of the beam and dissipated in other portions of the tube as heat, rather than as additional output power. This electron barrier, it was found, had prevented the pouring of more electrons through the hole in the rhumbatron. By shaping a magnetic force, it was found possible to concentrate more electrons into the beam and thus produce much more power output.

The development of the giant tube was described as a striking illustration of how the ingenious focusing method serves to break the barrier to permit the generation of millions of watts.

ANOTHER ARDC ELECTRONIC advancement has also appeared in a new compact airborne radar that assures greater safety for troop-carrying transports and essential cargo planes.

The new device weighs but 150 pounds; it has a single 5-inch screen, described as combining many radar functions of search and surveillance, accurate navigation over uncharted airlanes, detection of distant storms and best weather routes, anti-collision warning of mountain tops and tall structures, or of other nearby aircraft, while flying at any altitude up to 50,000 feet. In addition, the equipment incorporates radar beacon interrogation and reception.

The novel radar employs a turtle-shell shaped antenna that's 18 inches long and is gyro-stabilized for positive steadiness against the pitch and roll of the plane.

A wide choice of range scales for the viewing screen can be selected by the operator, for closeup enlargements variable from 3 to 30 miles, or fixed ranges of wider areas at 50, 100, and 240 miles. Areas shown may be oriented to current heading of the aircraft, or optionally to true North, or any desired compass bearing for exact measurement of drift.

One or more radar indicators may be operated with the system, and for large planes an optional 30-inch antenna is available. The radar set operates in the *X* or 10,000-megacycle band.

ELECTRONICS has also gone to the aid of our new jet and bomber planes, in the form of an all-channel transceiver operating automatically on any 20 of over a thousand u.h.f. or v.h.f. channels. Transmitter and receiver, containing 56 tubes and about 3000 parts, can be used in such extreme temperatures as 55 degrees below zero and at altitudes up to 50,000 feet.

AT THE FRANKLIN INSTITUTE LABORATORIES, the magic of electronics is also on parade. On exhibit is an electronic cane for the blind. Through a speaker that resembles a hearing aid, the cane sends a warning to its sightless user as its tip passes over a downstep or a curb.

There's also a novel device, called a *filpip* on view at the labs. Developed

(*Continued on page* 157)

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President
National Radio
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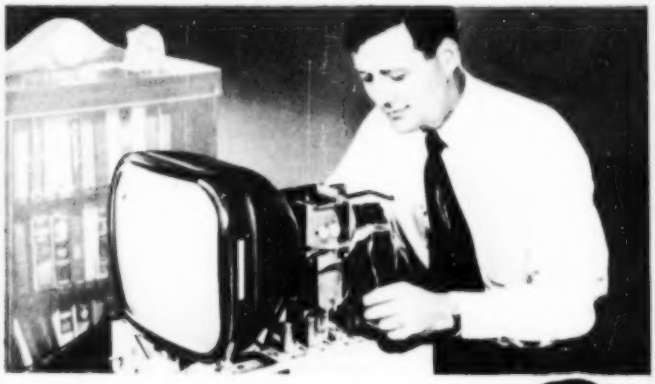
40 years of success
training men at
home in spare time.

I Will Train You at Home

for Good Pay Jobs, Success in

RADIO-TELEVISION

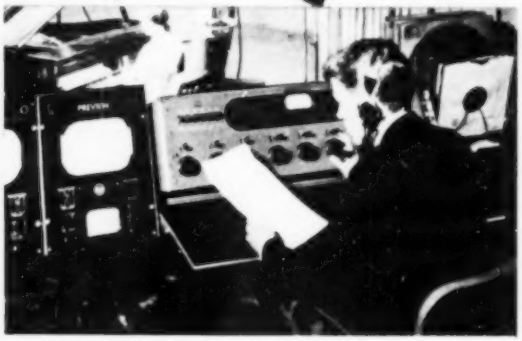


Practice Broadcasting with Equipment I Send

As part of my Communications Course I send you kits of parts to build the low-power Broadcasting Transmitter shown at the left. You use it to get practical experience putting a station "on the air," performing procedures demanded of Broadcasting Station Operators. An FCC Commercial Operator's License can be your ticket to a better job and a bright future; my Communications Course gives you the training you need to get your license. Mail card below and see in my book other valuable equipment you build.

Practice Servicing with Equipment I Send

Nothing takes the place of PRACTICAL EXPERIENCE. That's why NRI training is based on LEARNING BY DOING. You use parts I furnish to build many circuits common to Radio and Television. With my Servicing Course you build a modern Radio (shown at right). You build a Multitester which you use to help fix sets while training. Many students make $10, $15 a week extra fixing sets in spare time starting a few months after enrolling. All equipment is yours to keep. Card below will bring book showing other equipment you build.



Television is Growing Fast Making New Jobs, Prosperity

More than 25 million homes now have Television sets and thousands more are being sold every week. Well trained men are needed to make, install, service TV sets. About 200 television stations on the air with hundreds more being built. Think of the good job opportunities here for qualified technicians, operators, etc. If you're looking for opportunity get started now learning Radio-Television at home in spare time. Cut out and mail postage free card. J. E. Smith, President, National Radio Institute, Washington, D. C. OUR 40TH YEAR.

AVAILABLE TO VETERANS UNDER G.I. BILL

Good Jobs, Good Pay, Success in Radio-TV! SEE OTHER SIDE

CUT OUT AND MAIL THIS CARD NOW

Sample Lesson & 64-Page Book

Both FREE

This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive my 64-Page Book, "How to Be a Success in Radio-Television." Mail card now!

NO STAMP NEEDED! WE PAY POSTAGE

Mr. J. E. SMITH, President,
National Radio Institute, Washington 9, D.C.

Mail me Lesson and Book, "How to Be a Success in Radio-Television." (No Salesman will call. Please write plainly.)

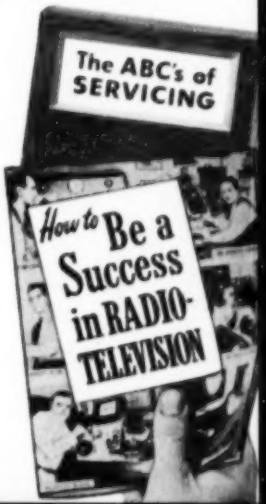
NAME AGE

ADDRESS

CITY ZONE STATE

VETS write in date of discharge

J K L M



Train at Home to Jump Your Pay as a RADIO-TV Technician

J. E. Smith, *President*
National Radio Institute

The men whose messages are published below were not born successful. Not so long ago they were doing exactly as you are now . . . reading my ad! They decided they should KNOW MORE . . . so they could EARN MORE . . . so they acted! Mail card below now.

Get a Better Job—Be Ready for a Brighter Future in America's Fast Growing Industry

Training PLUS opportunity is the PERFECT COMBINATION for job security, good pay, advancement. When times are good, the trained man makes the BETTER PAY, GETS PROMOTED. When jobs are scarce, the trained man enjoys GREATER SECURITY. NRI training can help assure you and your family more of the better things of life.

Radio-Television is today's opportunity field. Even without Television, Radio is bigger than ever before. Over 3,000 Radio Broadcasting Stations on the air; more than 115 million home and Automobile Radios are in use. Then add Television. Television Broadcast Stations extend from coast to coast now with over 25 million Television sets already in use. There are channels for 1,800 more Television Stations. Use of Aviation and Police Radio, Micro-Wave Relay, Two-way Radio communication for buses, taxis, trucks, etc. is expanding. New uses for Radio-Television principles coming in Industry, Government, Communications and Homes.

My Training is Up-to-Date You Learn by Practicing

Get the benefit of my 40 years experience training men. My well-illustrated lessons give you the basic principles you must have to assure continued success. Skillfully developed kits of parts I furnish "bring to life" the principles you learn from my lessons. Read more about equipment you get on other side of this page.

Naturally, my training includes Television. I have, over the years, added more and more Television information to my courses. The equipment I furnish students gives experience on circuits common to BOTH Radio and Television.

Find Out About the Tested Way to Better Pay

Read at the right how just a few of my students made out who acted to get the better things of life. Read how NRI students earn $10, $15 a week extra fixing Radios in spare time starting soon after enrolling. Read how my graduates start their own businesses. Then take the next step—mail card below.

You take absolutely no risk. I even pay postage. I want to put an Actual Lesson in your hands to prove NRI home training is practical, thorough. I want you to see my 64-page book, "How to Be a Success in Radio-Television" because it tells you about my 40 years of training men and important facts about present and future Radio-Television job opportunities. You can take NRI training for as little as $5 a month. Many graduates make more than the total cost of my training in two weeks. Mailing postage free card can be an important step in making your future successful. J. E. Smith, President, National Radio Institute, Washington 9, D. C. OUR 40TH YEAR.

Start Soon to Make $10 to $15 a Week Extra Fixing Sets

Keep your job while training. Many NRI students make $10, $15 and more a week extra fixing neighbors' Radios in spare time, starting a few months after enrolling. I start sending you special booklets that show you how to fix sets, the day you enroll. The multitester you build with parts I furnish helps discover and correct troubles.

SEE OTHER SIDE

I TRAINED THESE MEN

Consultant on Antenna Systems

"I resigned as Chief Engineer. Now I am on my own as consultant on private and commercial antenna systems." R.J. Bailey, Weston, W. Va.

$10 a Week in Spare Time

"Before finishing, I earned as much as $10 a week in Radio servicing, in my spare time. I recommend NRI". S. J. Petruff, Miami, Fla.

Control Operator, Station WEAN

"I received my license and worked on ships. Now with WEAN as control operator. NRI course is complete." R. Arnold, Rumford, R. I.

Has Own Radio-Television Shop

"Doing Radio and Television servicing full time. Have my own shop. I owe my success to NRI." Curtis Stath, Fort Madison, Iowa.

Radio-Television Service Chief

"Am chief Radio and Television serviceman for large repair shop. Pay very good; working conditions pleasant." F. G. Brogan, Louisville, Ky.

Got First Job Thru NRI

"My first job was with KDLR. Now Chief Engr. of Radio Equipment for Police and Fire Dept." F. Norton, Hamilton, Ohio.

My Training Leads to Jobs Like These

BROADCASTING
- Chief Technician
- Chief Operator
- Power Monitor
- Recording Operator
- Remote Control Operator

SERVICING
- Home and Auto Radios
- P.A. Systems
- Television Receivers
- Electronic Controls
- FM Radios

IN RADIO PLANTS
- Design Assistant
- Transmitter Design
- Technician
- Service Manager
- Tester
- Serviceman
- Research Assistant

SHIP AND HARBOR RADIO
- Chief Operator
- Assistant Operator
- Radiotelephone Operator

GOVERNMENT RADIO
- Operator in Army, Navy, Marine Corps, Coast Guard
- Forestry Service Dispatcher
- Airways Radio Operator

AVIATION RADIO
- Plane Radio Operator
- Transmitter Technician
- Receiver Technician
- Airport Transmitter Operator

TELEVISION
- Pick-Up Operator
- Voice Transmitter Operator
- Television Technician
- Remote Control Operator
- Service and Maintenance Technician

POLICE RADIO
- Transmitter Operator
- Receiver Serviceman

FIRST CLASS
Permit No. 20-R
(Sec. 34.9, P.L. & R.)
Washington, D.C.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In The United States

POSTAGE WILL BE PAID BY

NATIONAL RADIO INSTITUTE

16th and U Sts., N.W.

Washington 9, D. C.

CUT OUT—MAIL Postage Free CARD

SAMPLE LESSON and 64-PAGE BOOK Both FREE

Have Your Own Business

Many NRI trained men start their own successful Radio-Television sales and service business with capital earned in spare time. Joe Travers, a graduate of mine, in Asbury Park, N. J., writes: "I've come a long way in Radio and Television since graduating. Have my own business on Main Street."

NOW!

THESE FAMOUS ORIGINAL EQUIPMENT FAVORITES

available through selected local distributors

for SERVICE · EXPERIMENTAL · INDUSTRIAL · *and* MILITARY *uses*

For over 25 years, these Stackpole components have been sold only direct from the factory in huge production quantities to the world's leading equipment manufacturers.

Now, for the first time, you can get them in lots of up to 1,000 through selected parts distributors . . . fast and economically.

Every Stackpole component is produced under full quality control that extends from raw materials to final tests. And each type is fully proved through years of field service in the most exacting applications—military, service replacement, and commercial.

Write for bulletin on any type and name of nearest distributor.

STACKPOLE

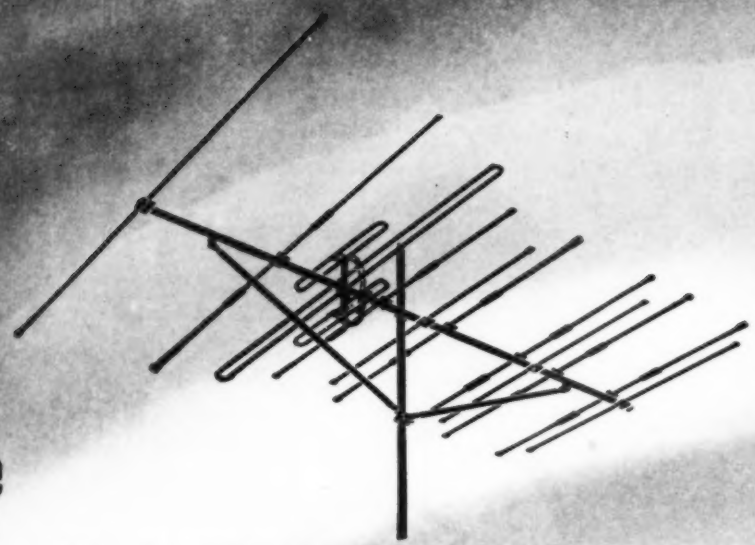
DISTRIBUTORS' DIVISION

STACKPOLE CARBON COMPANY

26 Rittenhouse Place, Ardmore, Pa.

(Plants in St. Marys and Kane, Pa.)

This is **CHANNEL MASTER'S** *greatest antenna discovery!*



the

RAINBOW*

the most important antenna development since the introduction of the basic Yagi!

The World's First Triple-Powered Yagi...

Brilliant all-channel VHF performance — and really ready for COLOR!

Stacked
SUPER RAINBOW
model no. 331-2

- No other antenna provides such outstanding long distance reception in black and white.
- No other antenna is so well prepared to meet the exacting requirements of color television: Uniform high gain, flat frequency response, extremely narrow polar patterns, highest front-to-back ratios.

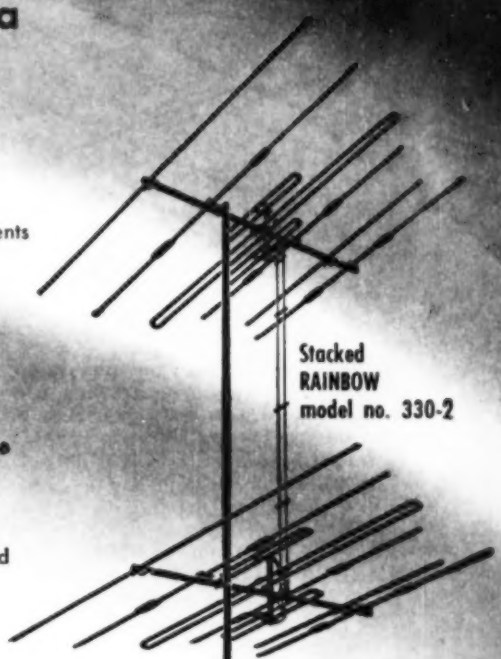
Single bay
SUPER RAINBOW
model no. 331

these 3 basic engineering sciences

make the RAINBOW the most powerful all-channel VHF antenna science has yet produced.

1. **New spacing formula:** Channel Master research has now established new, more efficient relationships between the Yagi's parasitic elements (directors and reflectors) — far greater efficiency than a screen. **The radical new spacing arrangement between these elements has, for the first time, extended the full efficiency and high gain of the basic narrow band Yagi over the *full width of an entire VHF band.***
2. **New "triple power" High Band directors and reflector:** Three-segment directors and reflectors, with each segment insulated from its adjacent segment, provide the combined power of three High Band Yagis, operating side by side, in perfect phase. This is the first time an *entire antenna* has been made to operate on the same high gain principle as the fabulous Tri-Pole.
3. **New "intermix" design:** Combines — into one single antenna — two separate, *independent* sets of directors and reflectors, one for High Band, one for Low Band. Each parasitic system operates *only* on its own band. No compromise design. No interaction. No signal loss.

PLUS Channel Master's original, super-gain TRI-POLE . . . the unique triple-powered dipole that made the Champion the most wanted antenna in America.



Stacked RAINBOW model no. 330-2

Single bay RAINBOW model no. 330

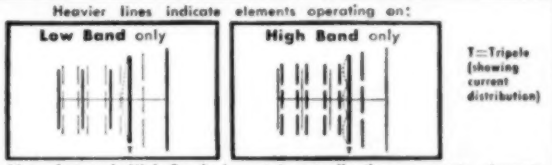
2 great models available:

RAINBOW, Model No. 330 — for secondary and near-fringe areas.

SUPER RAINBOW, Model No. 331 — for fringe and super-fringe areas.

Full band width — highest gain — of any all-channel antenna.

Diagram illustrates independent operation of the RAINBOW's High Band and Low Band parasitic elements. Note unique new spacing arrangement between elements.



Note that each High Band element is actually three separate elements, each insulated from the others, for triple-powered performance.

Here's how the RAINBOW out-performs the famous Champion.

	CHANNEL	2	3	4	5	6	7	8	9	10	11	12	13
Gain Over 1-Bay Champion	1-Bay RAINBOW	0 DB	0 DB	0 DB	+1 DB	+2 DB	+3 DB	+2.5 DB	+1 DB	+.5 DB	+.5 DB	+1.5 DB	+2.5 DB
	1-Bay SUPER RAINBOW	+1 DB	+1 DB	+1.5 DB	+2.5 DB	+3.5 DB	+3.5 DB	+3 DB	+2 DB	+1.5 DB	+2 DB	+3.5 DB	+4.5 DB
	CHANNEL	2	3	4	5	6	7	8	9	10	11	12	13
Gain Over Stacked Champion	Stacked RAINBOW	+1.5 DB	+2 DB	+1.5 DB	+1.5 DB	+2 DB	+.5 DB	+.5 DB	+0 DB	+0 DB	+0 DB	+1 DB	+1.5 DB
	Stacked SUPER RAINBOW	+2 DB	+2.5 DB	+3 DB	+3 DB	+4 DB	+.5 DB	+1 DB	+1 DB	+2 DB	+2 DB	+2.5 DB	+3.5 DB

Horizontal Polar Pattern (relative voltage)

Write for complete technical literature

Seen in October Coronet MAGAZINE

CHANNEL MASTER CORP.
ELLENVILLE, N. Y.
THE WORLD'S LARGEST MANUFACTURER OF TV ANTENNAS

Don't let any Antenna Manufacturer pitch curves to you!

new WINEGARD INTERCEPTOR

with Exclusive Electro-Lens* Focusing means . . .

Don't be misled by any manufacturer's "homemade" charts on antenna performance. We can show you how to plot curves that will "prove" that a busted steel guitar on an 8-ft. flagpole outperforms any antenna you can name —even our own superb *Winegard* INTERCEPTOR.

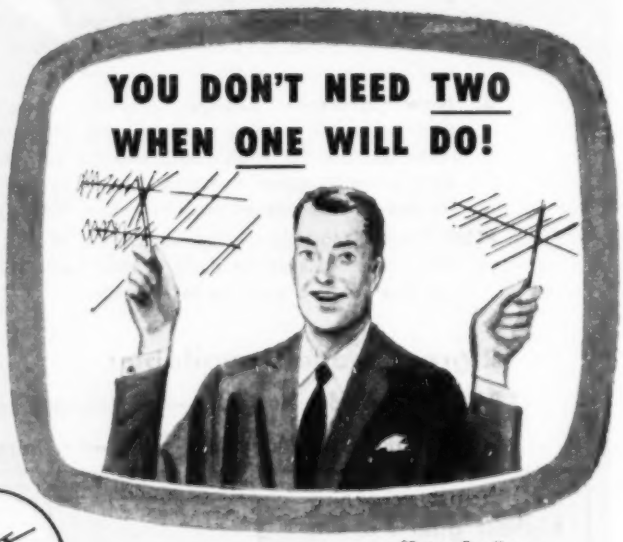
No—all that counts is, PERFORMANCE IN ACTUAL USE. Therefore, DO THIS: Use a *single* INTERCEPTOR on your next installation where you'd ordinarily stack two bays. See if *one* INTERCEPTOR doesn't give better results than any stacked installation you have made nearby. Once in a blue moon, a second bay is necessary even with our INTERCEPTOR. But rarely. So we say to you, "Why use *two* when ONE will do?"

Order an INTERCEPTOR today. Let it tell its own story in the only place it counts—on one of your own installations. If it doesn't far surpass any other antenna you've ever used, fire it back to us! We'll return your money—and we'll still be friends! So . . . order NOW!

A FAR BETTER PICTURE OR YOUR MONEY BACK!

Antenna No.	Winegard Trade Name	List Price
L-4	INTERCEPTOR	$24.95 a bay
L-5	PIXIE	$14.95 a bay

Shipped, one L-4 to a carton (stacking bars available)
Shipped, two L-5's to a carton with stacking bars.



*Patent Pending

THE INTERCEPTOR gives the clearest, sharpest pictures obtainable . . . not just on one or two channels . . . but on all *12* VHF channels.

WINEGARD PIXIE
A quality all VHF channel antenna for top performance at a low price.

See your jobber now or write us for complete information.

WINEGARD COMPANY
3000 Scotten Boulevard, Burlington, Iowa

VETERANS . . . NON-VETERANS

You can be a TELEVISION TECHNICIAN

I'LL TRAIN YOU AT HOME IN YOUR SPARE TIME FOR BETTER-PAYING JOBS IN THE DYNAMIC RADIO-TELEVISION-ELECTRONICS FIELD.

L. L. Lane, B.S., M.A.
President, Radio-Television Training Association. Executive Director, Pierce School of Radio & Television.

Not since the beginning of the Industrial Revolution in the 18th Century have there been such amazing technological advances in the wide open Radio-Television-Electronics field. And there's no end in sight . . . FM — UHF — HIGH FIDELITY — COLOR TELEVISION — RADAR — LORAN — all magic words holding out the promise of good-paying jobs with a secure future . . . for qualified men.

NOW, while opportunities for trained men are still increasing, is the time to prepare yourself to advance with the ever-expanding, Radio-Television-Electronics field. You can become a well-paid TELEVISION TECHNICIAN by letting me start your training now!

VETERANS My School fully approved to train Veterans under new Korean G.I. Bill. Available only to Veterans discharged after AUGUST 20, 1951. If eligible, CHECK COUPON.

EARN WHILE YOU LEARN. Almost from the very start you can earn extra money while learning by repairing radio-TV sets for friends and neighbors. Many of my students earn up to $25 a week . . . pay for their entire training from spare time earnings . . . start their own profitable service business.

FREE FCC COACHING COURSE. Important for BETTER PAY JOBS requiring FCC license. You get this training AT HOME and AT NO EXTRA COST. Top jobs go to FCC-licensed technicians.

RADIO-TELEVISION TRAINING

My Radio-FM-Television Technician Course is especially prepared for men with no previous experience or training. I have trained hundreds of men for successful careers in radio-television-electronics. Many of them had only a grammar school education and no previous experience whatsoever in the field.

EXTRA FM-TV TECHNICIAN TRAINING

My FM-TV Technician Course lets you take full advantage of your previous experience — either civilian or Armed Forces. YOU CAN SAVE MONTHS OF TIME . complete your training by getting a thorough background in Frequency Modulation and Television Theory and PRACTICE.

You "Learn by Doing", working with parts and equipment I send you. YOU BUILD AND KEEP A TV RECEIVER.

EXTRA TRAINING IN NEW YORK CITY AT NO ADDITIONAL COST

You get two weeks, 50 hours, of intensive laboratory work on modern electronic equipment at our associate school in New York City — Pierce School of Radio & Television. I give you this **AT NO EXTRA COST** whatsoever, after you finish your home study training in the Radio-FM-TV Technician Course or the FM-TV Technician Course. Your home study course is complete without this two-week laboratory session, but it is one of the many Extras available to you from RTTA.

YOU GET ALL THIS EQUIPMENT AND MORE

As part of your training, I give you all the equipment you need to set up your own home laboratory and prepare for a BETTER PAY TV JOB. You build and keep a professional GIANT SCREEN TV RECEIVER complete with big picture tube (designed and engineered to take any size up to 21-inch) . . . also a Super-Het Radio Receiver, RF Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Transmitter, Public Address System, AC-DC Power Supply. Everything supplied, including all tubes.

Mr. Leonard C. Lane, President — Dept. T-11
RADIO-TELEVISION TRAINING ASSOCIATION
52 East 19th Street, New York 3, N. Y.

Dear Mr. Lane: Mail me your NEW FREE BOOK, FREE SAMPLE LESSON, and FREE aids that will show me how I can make BIG MONEY IN TELEVISION. I understand I am under no obligation and no salesman will call.

(PLEASE PRINT PLAINLY)

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

I AM INTERESTED IN:

- ☐ Radio-FM-TV Technician Course
- ☐ FM-TV Technician Course
- ☐ TV Conversion & Studio Technician Course

VETERANS! Check here ☐ for Training under NEW G.I. Bill.

Radio Television Training Association

52 EAST 19th STREET • NEW YORK 3, N. Y.

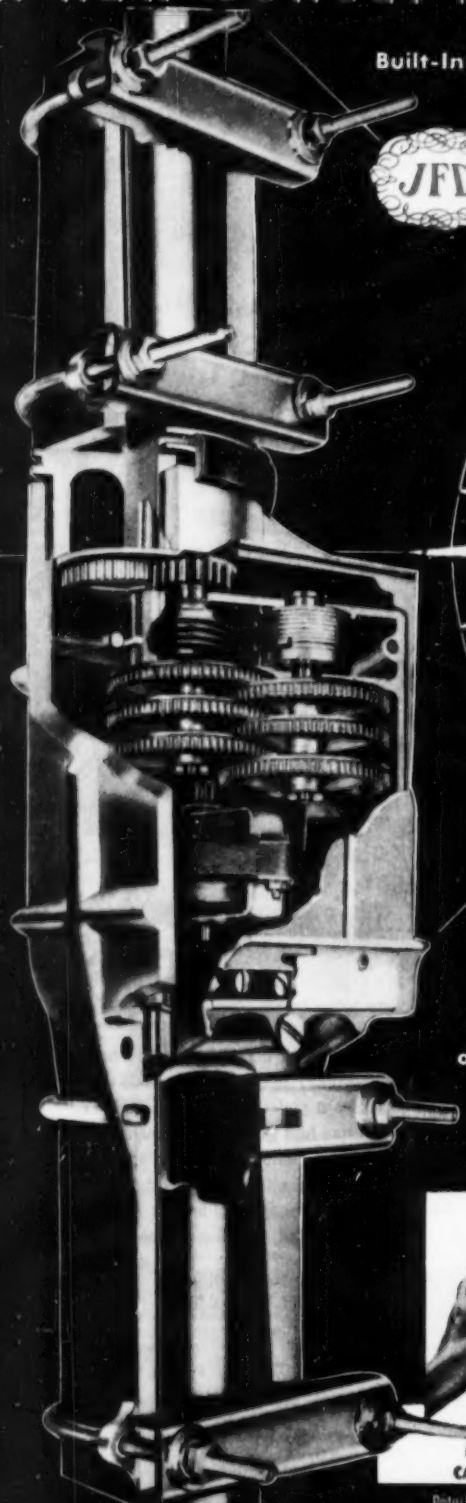
Licensed by the State of New York • Approved for Veteran Training

A NEW CONCEPT IN ROTATOR ENGINEERING!

Built-In Thrust Bearing—3200: 1 Reduction Gear Train—Dynamic Braking!

JFD

ROTO KING



PIANO KEYBOARD TUNING! Finger-tip control tuning. Precise antenna position indicated at all times. Magnificently styled console is a joy to behold.

Especially designed for fidelity reception of sharply directional color transmission. The JFD Roto King is the first ever engineered to overcome shortcomings of conventional rotator design which seriously affect the accuracy of antenna position and indication: ambiguity (error) and voltage fluctuation. The result is stop-watch tuning of antenna for fidelity reception of critically directional VHF, UHF and color signals especially.

CARTRIDGE SERVICING!

Detachable power drive unit can be removed in seconds. No laborious dismantling of antenna.

STOP WATCH TUNING ACCURACY!

Ultra sensitive control system accurate within ½ degree of desired position. Instant stop. No ambiguity. No drift or error.

360 DEGREE ROTATION IN EITHER DIRECTION

Complete 360 degree revolution permits station selection beyond end of normal 360 degree traverse.

JFD Electronics

JFD MANUFACTURING CO., INC., BROOKLYN 4, NEW YORK

Model RT100-M Mahogany	**$44.95 List**
Model RT100-IV Ivory	**$44.95 List**

Home Study Courses in TELEVISION SERVICING offered by RCA INSTITUTES

Study Television Servicing—from the very source of the latest, up-to-the-minute TV and Color TV developments. Train under the direction of men who are experts in this field. Take advantage of this opportunity to place yourself on the road to success in television. RCA Institutes, Inc. (A Service of Radio Corporation of America), thoroughly trains you in the "why" as well as the "how" of servicing television receivers.

FIRST HOME STUDY COURSE IN COLOR TV SERVICING

Now you can train yourself to take advantage of the big future in Color TV. RCA Institutes Home Study Course covers all phases of Color TV Servicing. It is a practical down-to-earth course in basic color theory as well as how-to-do-it servicing techniques.

This color television course was planned and developed through the combined efforts of instructors of RCA Institutes, engineers of RCA Laboratories, and training specialists of RCA Service Company. You get the benefit of years of RCA research and development in color television.

Because of its highly specialized nature, this course is offered only to those already experienced in radio-television servicing. Color TV Servicing will open the door to the big opportunity you've always hoped for. Find out how easy it is to cash in on color TV. *Mail coupon today.*

SEND FOR FREE BOOKLET

Mail coupon in envelope or paste on postal card. Check course you are interested in. We will send you a booklet that gives you complete information. *No salesman will call.*

RCA

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

HOME STUDY COURSE IN BLACK-AND-WHITE TV SERVICING

Thousands of men in the radio-electronics industry have successfully trained themselves as qualified specialists for a good job or a business of their own—servicing television receivers. You can do this too.

This RCA Institutes TV Servicing course gives you up-to-the-minute training and information on the very latest developments in black-and-white television.

As you study at home, in your spare time, you progress rapidly. Hundreds of pictures and diagrams, easy-to-understand lessons help you to quickly become a qualified TV serviceman.

There are ample opportunities in TV, for radio servicemen who have expert training. Mail coupon today. Start on the road to success in TV Servicing.

MAIL COUPON NOW

RCA INSTITUTES, INC.
Home Study Dept. RN-1154
350 West Fourth Street, New York 14, N. Y.

Without obligation on my part, please send me copy of booklet on:

- ☐ Home Study Course in TELEVISION SERVICING.
- ☐ Home Study Course in COLOR TV SERVICING.

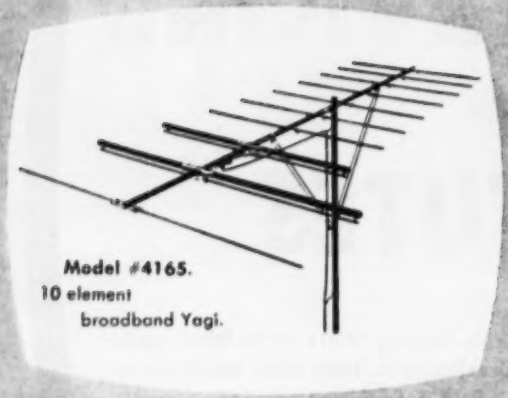
Name_____
(please print)

Address_____

City_____ Zone____ State_____

A new standard in electrical and mechanical perfection in all 32 new YAGI antennas

Featuring the new WALSCO "Octopus" **Model #4110.** A combination Yagi-conical for superlative all-channel reception.

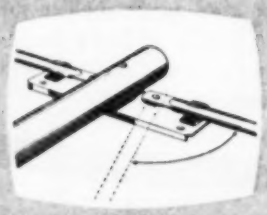


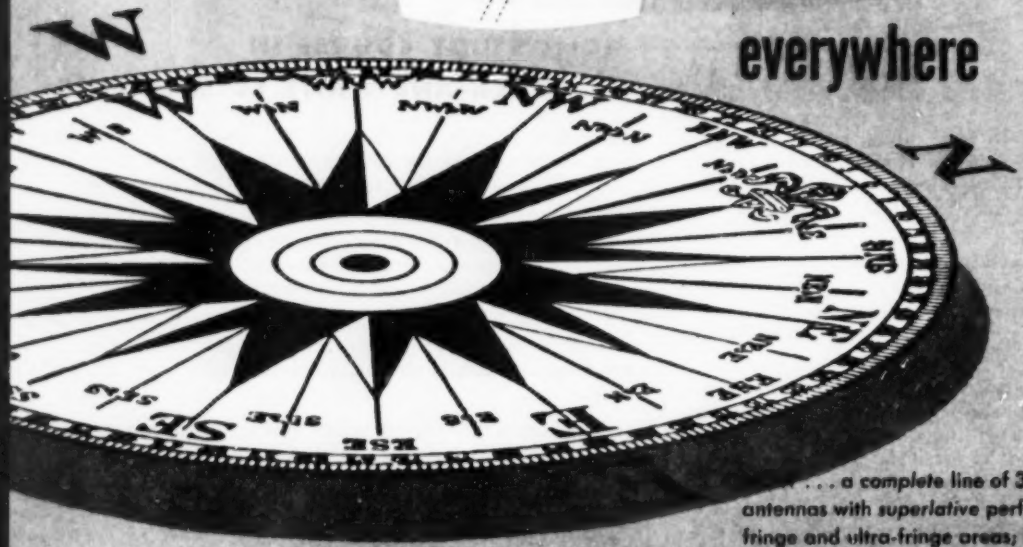
Model #4165. 10 element broadband Yagi.

WALSCO "futurized" YAGIS reach everywhere

Model #4160 series. 5 element, single channel Yagis.

Walsco's exclusive "umbrella" snap-out design provides perfect element alignment instantly.





. . . a complete line of 32 "futurized" Yagi antennas with superlative performance . . . for fringe and ultra-fringe areas; for black and white and color on all present and future channels. No loose hardware . . . completely pre-assembled using Walsco's exclusive "umbrella" snap-out design. Nothing compares at any price!

Write for complete information on all 32 "futurized" Yagi models

Walsco

ELECTRONICS CORPORATION

3602 Crenshaw Blvd. • Los Angeles 16, California

Overseas Distributor:
Ad Auriemo, Inc. • 89 Broad St., New York 4, N.Y.

ADVANCE! Raise your earning power—learn RADIO-TELEVISION-ELECTRONICS by SHOP-METHOD HOME TRAINING

GOOD JOBS AWAIT THE TRAINED RADIO-TV TECHNICIAN

There is a place for *you* in the great Radio-Television-Electronics industry when you are trained as National Schools will train you at home!

Trained technicians are in growing demand at good pay—in manufacturing, broadcasting, television, communications, radar, research laboratories, home Radio-TV service, and other branches of the field. National Schools Master Shop-Method Home Training, with newly added lessons and equipment, trains you in your spare time, right in your own home, for these fascinating opportunities. OUR METHOD IS PROVED BY THE SUCCESS OF NATIONAL SCHOOLS TRAINED MEN, ALL OVER THE WORLD, SINCE 1905.

EARN WHILE YOU LEARN

Many National students pay for all or part of their training with spare time earnings. We'll show you how you can do the same! Early in your training, you receive "Spare-time Work" Lessons which will enable you to earn extra money servicing neighbors' and friends' Radio and Television receivers, appliances, etc.

MASTER ALL PHASES!

Get Master Shop-Method Home Training from an Established Practical Resident School with its own Training Shops, Laboratories, Studios — almost 50 Years of Successful Experience in Training Ambitious Men.

We Bring National Schools To You!

Superheterodyne Receiver

Signal Generator — Audio Oscillator — T.R.F. Receiver

LEARN BY DOING

You receive and keep all the modern equipment shown above, including tubes and valuable, professional quality Multitester. *No extra charges.*

FREE! RADIO-TV BOOK AND SAMPLE LESSON!

Send today for National Schools' new, illustrated Book of Opportunity in Radio-Television-Electronics, and an actual Sample Lesson. No cost—no obligation. Use the coupon now—we'll answer by return airmail.

APPROVED FOR VETERANS AND NON-VETERANS
Check coupon below

Both Resident and Home Study Courses Offered!

National Schools Training is All-Embracing

National Schools prepares you for your choice of many job opportunities. Thousands of home, portable, and auto radios are being sold daily—more than ever before. Television is sweeping the country, too. Co-axial cables are now bringing Television to more cities, towns, and farms every day! National Schools' *complete* training program qualifies you in all fields. Read this partial list of opportunities for trained technicians:

Business of Your Own • Broadcasting
Radio Manufacturing, Sales, Service • Telecasting
Television Manufacturing, Sales, Service
Laboratories: Installation, Maintenance of Electronic Equipment
Electrolysis, Call Systems
Garages: Auto Radio Sales, Service
Sound Systems and Telephone Companies, Engineering Firms
Theatre Sound Systems, Police Radio
And scores of other good jobs in many related fields.

TELEVISION TRAINING

You get a complete series of up-to-the-minute lessons covering all phases of repairing, servicing and construction. The same lesson texts used by resident students in our modern and complete Television broadcast studios, laboratories and classrooms!

NATIONAL SCHOOLS

LOS ANGELES 37, CALIFORNIA • ESTABLISHED 1905
IN CANADA: 811 W. HASTINGS STREET, VANCOUVER, B.C.

GET FACTS FASTEST! MAIL TO OFFICE NEAREST YOU!

(mail in envelope or paste on postal card)

NATIONAL SCHOOLS, Dept. RH-114

4000 S. Figueroa Street, Los Angeles 37, Calif. or **323 West Polk Street, Chicago 7, Ill.**

Send FREE Radio-TV Electronics book and FREE sample lesson. No obligation, no salesman will call.

NAME _____ BIRTHDAY _____ 19 ____

ADDRESS _____

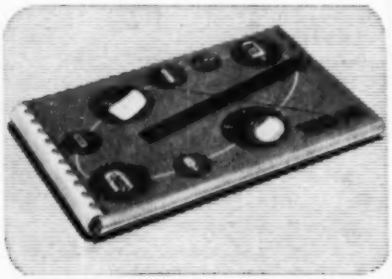
CITY _____ ZONE ____ STATE _____

☐ Check here if interested in Resident School Training at Los Angeles.

VETERANS: Give Date of Discharge _____

TUNG-SOL TECHNICAL DATA PAYS OFF IN SERVICE!

T-58 700 pages—600 tube types



NEW! 1954 Edition! T-70 200 pages of data on CR tubes, receiving and special tubes, dial lamps

T-31 300 blueprint base diagrams for 1100 tube types

Here's the most practical set of tube reference books in the industry—all the information you need for everyday jobs! They're easy to read—easy to use (always lie flat when open). You'll get work done faster with Tung-Sol Technical Data Books. Ask your tube supplier about them.

TUNG-SOL ELECTRIC INC., Newark 4, N. J.
Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Seattle.

50 years

TUNG-SOL®
easy reference
TECHNICAL DATA

Tung-Sol makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

Within the INDUSTRY

HERBERT A. GUMZ has been elected president and chief executive officer of *Crescent Industries Inc.* of Chicago.

Prior to joining the firm, Mr. Gumz was associated with *Webster - Chicago Corp.* for 11 years, his last position being that of executive vice-president. He is active in industry and civic affairs in the Chicago area.

He will maintain offices at the company's plant at 5900 W. Touhy Ave.

* * *

ELECTRONIC TUBE CORPORATION of Philadelphia has been purchased by Kenneth C. Meinken, former president of **NATIONAL UNION RADIO CORPORATION.** He is serving as president of the Philadelphia firm . . . **KEPS ELECTRIC COMPANY's** high-fidelity studio in downtown Pittsburg has been sold to W. S. Potter, former vice-president of the company. The studio will be operated as **CONCERTO ROOM, INC.** at 642 Grant Street with no changes in operating personnel . . . Max Baume has resigned as national sales manager for **BROOK ELECTRONICS, INC.** to open a representative's office, **BAUME ELECTRONIC SALES COMPANY** in Whitestone, Long Island . . . **JAMES M. SCALES COMPANY** has been formed on the West Coast and will maintain offices in the Western Merchandise Mart in San Francisco. The company will act as manufacturers' representatives in electronic equipment and supplies . . . **ORRADIO INDUSTRIES,** manufacturer of *"Irish"* brand recording tape, has purchased the recording tape reel division of **COMPCO CORPORATION** of Chicago, one of the largest producers of aluminum reels for magnetic tape.

* * *

ROBERT J. CALDWELL has been appointed manager of the recently-established New Products Department of *National Company, Inc.* His job will be to coordinate the department's program of expansion and development.

The new department was established to meet the needs of the company's rapid expansion in the electronic field. The department will bring out new items developed within the company itself and launch an intensified program of development of products from other sources.

Mr. Caldwell holds both bachelor and master degrees in electrical engineering from MIT and has taken advanced work at both MIT and Harvard. He is a member of the AIEE and a senior member of the IRE.

* * *

JOSEPH F. WHITAKER has been named vice-president in charge of sales for *Weller Electric Corporation* of Easton, Pa.

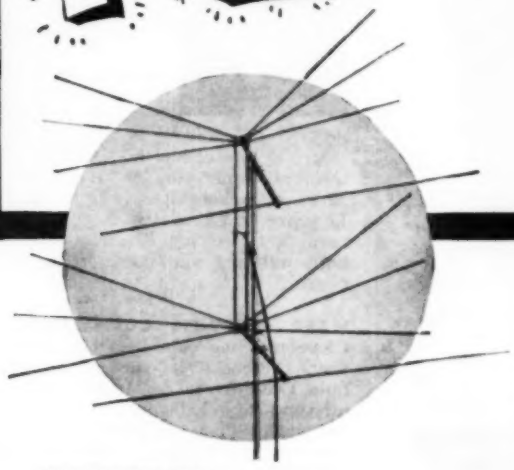
In his new capacity, Mr. Whitaker will plan and supervise the national promotion and sales of the company's soldering guns, soldering kits, and power sanders.

Formerly with *International Resistance Company* of Philadelphia, he has been active in electronic component sales for the past ten years. He joined *Weller* last year as sales manager.

* * *

WILLIAM BALDERSTON, president of *Philco Corporation,* has been named chairman of the board and **JAMES H. CARMINE** elected to fill the post of president . . . **LEON B. UNGAR,** of *Ungar Electric Tools, Inc.* has been elected president of the Radio Parts & Electronic Equipment Shows, Inc., sponsors of the industry's Electronic Parts Show held annually in Chicago . . . **ROBERT S. BURROS** has been named advertising and sales promotion manager of *Olympic Radio & Television Inc.* . . . **THEODORE ROSSMAN** of *Pentron Corp.* was elected chairman of the Association of Electronic Parts & Equipment Manufacturers. EP&EM is a trade group consisting of 118 electronics firms in the midwest . . . **ROBERT G. SCOTT** is the new assistant sales manager for the cathode-ray tube division of *Allen B. Du Mont Laboratories, Inc.* . . . **JOHN C. BIRREL** has been named placement director of *Northwest Radio and Television School,* the nationally-known correspondence school in Portland, Oregon . . . *Erie Resistor of Canada Limited* has named **G. FRED EATON** to the post of sales manager . . .**GEORGE H. L. NORMAN** has joined *Sprague Electric Co.* as coordinator of the company's activities in the field of electronic computer components. He was formerly associated with *Corning Glass Works* . . . *Electro-Voice, Inc.* has named **EVERETT E. LEEDOM** to the post of advertising manager . . . **THEODORE ROSSMAN** has assumed the duties of industrial sales manager of the *Pentron Corporation.* He is vice-president of the firm . . . **PAUL NEWTON COOK** is the new jobber sales manager for *Chicago Standard Transformer Corporation* . . . *Technical Tape Corporation* has named **FREDERICK I. KANTOR** national sales

NEW PHILCO Super Performance TV ANTENNAS



PHILCO TWO-BAY SUPER CONICAL

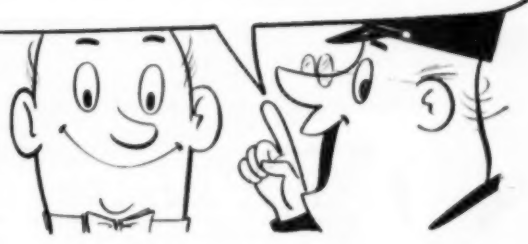
Strong signal pick-up on all VHF-UHF channels. Ideal for fringe area reception . . . aluminum construction with dowelled elements: Part No. 45-3096-2. Single bay design: Part No. 45-3096.

BUILD CUSTOMER CONFIDENCE . . . MORE SALES FOR YOU!

Designed to outperform any equivalent antenna in its class, each Philco Super Performance TV Antenna provides the finest picture possible . . . long life and ease of installation. Powerful Conical . . . all-aluminum VHF Yagis, engineered for quick rigging . . . light weight. Stacked versions provide top-quality fringe area reception. Only six UHF Yagis cover the entire UHF spectrum. Here's powerful reception on all channels . . . the kind that builds customer confidence . . . more sales for you !

GET YOUR "PHILCO FREE RIDE"

That's right! Ride any way you like it . . . or earn all of them! They're yours FREE with PHILCO FREE RIDE TICKETS . . . and there's no waiting! Collect your selected "ride" as soon as you have the necessary number of tickets. You can enjoy Rollfast Roller Skates; Radio Flyer Coaster Wagon; Rollfast Bicycle; BMC Juvenile Tractor; Airplane Trip for Two; ½ Ton Panel Dodge Truck; Plymouth Plaza Sedan. Concentrate your parts and accessories purchases on PHILCO and make double profits . . . profits through the great ready-made PHILCO market of PHILCO owners and PLUS



PROFITS with these great FREE RIDES . . . all at no extra cost to you. Don't wait . . . register NOW! Get started on your FREE RIDE with PHILCO!

SEE YOUR PHILCO DISTRIBUTOR FOR DETAILS

PHILCO Famous for QUALITY the World Over

PHILCO CORPORATION

ACCESSORY DIVISION

"A" AND ALLEGHENY AVE., PHILADELPHIA 34, PA.

Compare AND YOU WILL CHOOSE . . .

"Largo" . . . musical term—"with breadth and dignity."

New Specially Designed Horn-loaded High Fidelity Speaker System

The Largo is a complete wide range speaker system utilizing the new Permoflux 8V81 Super Royal Eight speaker and 32 KTR Super Tweeter in an acoustically advanced enclosure scientifically matched to the speaker characteristics. The enclosure is an entirely new and unique horn-loaded non resonant baffle with horn loading of the speaker back wave accomplished in the cabinet base. Every inch of the cabinet construction serves an acoustically useful purpose.

Baffle and speaker characteristics were matched octave by octave through laboratory tests to provide undistorted reproduction of all frequencies from 35 cycles to 16,000 cycles. Power handling capacity is 15 watts. A high frequency balance control is provided for matching individual room characteristics.

Its low contemporary styling is gracefully proportioned for decorative blending with the finest room decor. Precision constructed of selected ¾" Mahogany and Korina veneers.

A Permoflux Exclusive: Special connection for headset extension cord for private listening and hard of hearing music lovers.

The Largo . . . Audiophile Net Price **$99.75**

Enclosure styled by Contemporary American Furniture.

The Fortissimo—A 2-way multiple speaker system. Unique "New Dual Driving Point" Enclosure Design surpasses bass and mid-range performance of finest 12 and 15 inch systems. With 2 Super Royal 8 speakers and Super Tweeter. Cabinet beautifully styled in Mahogany or Korina Blonde veneers. Audiophile Net Price **$218.00**

The Diminuette—A 2-way speaker system featuring full high fidelity performance with minimum cabinet size and low cost. With 2 Royal 6 speakers and Super Tweeter. In Mahogany or Blonde finish. Audiophile Net Price **$49.50**

Visit your Hi-Fi dealer for a demonstration; also hear the New Super Royal Speaker (8, 12, and 15 inch sizes).

Send today for complete descriptive literature.

Permoflux CORPORATION

4918 West Grand Avenue
Chicago 39, Illinois

West Coast Plant 4101 San Fernando Road Glendale 4, California

manager of its Electro-Magnetic Products Division . . . **RICHARD T. ORTH** has joined *Westinghouse Electric Corporation* as vice-president in charge of the electronic tube division. He was formerly vice-president of *RCA*.

• • •

LYMAN E. G. SUITER has been appointed assistant to the vice-president of *Fairchild Recording Equipment Company* and will assist in general manufacturing problems due to the rapid expansion of the company's activities. Their interests are in both the high-fidelity and theater equipment fields.

Mr. Suiter comes to *Fairchild* from the radio division of *Westinghouse Electric Corporation* where for the last 14 years he has served in a variety of manufacturing supervisory positions on both military and commercial equipment.

• • •

WARD PRODUCTS CORPORATION of Cleveland has established a new antenna research laboratory in Ashtabula, Ohio for the design and testing of all types of television and automotive antennas. The new laboratory will supplement the facilities of **GABRIEL ELECTRONICS** in Needham, Mass., another division of the same parent firm . . . **THE R. T. BOZAK COMPANY** of Stamford, Conn. has leased a new building on the Post Road in South Norwalk which will house the expanded operations of the speaker firm . . . **ESC CORPORATION,** manufacturer of delay lines, filter networks, pulse transformers, etc., recently moved into a new building at 534 Bergen Blvd., Palisades Park, N. J. . . . **S. & A. ELECTRONICS,** antenna manufacturer, has moved to new and larger quarters at 1025 Nevada St. in Toledo, Ohio . . . **RCA SERVICE COMPANY** has established three new offices covering the West Coast area to handle *"Antenaplex"* TV systems business. The offices are at 718 Dearborn in Seattle; 911 N. Orange Drive, Hollywood; and 2640 Bayshore Blvd., San Francisco . . . **ANCHOR DISTRIBUTING COMPANY** has moved to 933 Penn Ave. in Pittsburgh . . . A $200,000 branch electronics assembly plant has been dedicated by **WEBSTER-CHICAGO CORPORATION** in New Ulm, Minn. The new plant will employ between 250 and 300 people . . . **FRYLING ELECTRIC PRODUCTS, INC.,** a subsidiary of **ERIE RESISTOR CORP.,** recently opened its new manufacturing plant in Holly Springs, Mississippi. The new plant is devoted exclusively to the production of electronic products and custom molded plastic parts . . . **LOWELL MANUFACTURING COMPANY** has expanded its production facilities for low-level sound equipment by building a new plant on Wall Street and Luda Ave. in St. Louis, adjacent to its main factory. It will cover 10,000 square feet on two floors . . . **RAYTHEON MANUFACTURING**

(*Continued on page* 164)

WAR DECLARED ON DEALER CALL-BACKS!

NEW TUBE TYPES FROM SYLVANIA SPEARHEAD ATTACK!

The most important step in a concentrated campaign to eliminate dealer call-backs has been taken by Sylvania with the release of a group of new tube types. Sylvania's new 5U4GB leads the group.

The 5U4GB attacks the call-back enemy on many different fronts:

1. The tube has been re-designed. Now, plates are longer and heavier with twin wings for better heat dissipation, Sylvania's 5U4GB carries increased ratings of 275 ma at 44 volts drop with 1.0 amp peak plate current.
2. Wafer Stem Construction—originally developed by Sylvania for the lock-in tube—has been adapted to the 5U4GB. The wafer stem eliminates electrolysis, provides stronger mount construction, permits better spacing.
3. A new T-12 bulb provides greater heat dissipation, gives added strength, more rigidity because of its straight construction.
4. Bottom mica has been added to make the tube stronger, improve filament alignment and eliminate arcing.

Other Sylvania types are vastly improved, too! All have Sylvania's famous wafer stem construction, plus these additional design features:

- Better Lead Spacing
- Stronger Mount Supports
- Stronger Micas
- Firmer Filament and Plates
- Greater Protection Against Shock and Vibration
- Better Heat Dissipation
- No Glass Electrolysis
- Fewer Burnouts
- Stronger, More Rugged Overall Construction

NO MINOR SKIRMISH

The Sylvania war on dealer call-backs is not a minor skirmish. It will continue until dealer call-backs on these and other receiving tube types are completely eliminated. The dealer's biggest profit-robbing enemy can look forward only to an incessant, continuing effort on the part of Sylvania to make his existence a thing of the past. These quality tubes are now at your Sylvania distributor's.

TO IDENTIFY SYLVANIA'S NEW RECEIVING TUBES LOOK FOR THE NEW CARTON!

SYLVANIA

Sylvania Electric Products Inc. 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., St. Catherine Street, Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION

This new tube carton identifies Sylvania's new high quality, improved receiving tubes. It's assurance to dealers of the finest receiving tubes made—unsurpassed for quality and performance. For further information write to Dept. 4R-3511 at Sylvania.

Bell's new Telephone Answering Set. In use, the machine tells the caller when to start talking, and when his time—thirty seconds—is up.

He's out . . .
but he's answering his telephone!

This newly designed Bell Telephone Answering Set makes it possible for you to go out—but leave your voice behind.

Before you leave you twist a knob, dictate a message into your telephone, then switch the machine to "Automatic Answer." When somebody calls, the machine starts up and the caller hears your voice telling who you are, requesting his name and telephone number, repeating whatever you have said. The reply is recorded too. On your return you play back all the calls that have come in, as often as you please.

The new machine features "talking rubber," a Laboratories-developed recording medium made of rubber-like plastic and iron oxide which can be used over and over again millions of times. It is another example of how Bell Laboratories research works to help your local Bell Telephone Company serve you.

Bell Telephone Laboratories

Improving telephone service for America provides careers for men in scientific and technical fields

GET READY FOR THE CHRISTMAS *RU$H...*

G-E *Custom Hi-Fi*

Dual Coaxial Speaker A1-400

Speaker Enclosure (Blend, Mahogany or Unfinished Veneers) A1-406

Preamplifier-Control Unit A1-200

Power Amplifier A1-300

Baton Tone Arms: A1-500 (12") A1-501 (16")

GREATEST PROFIT

FINEST PERFORMANCE

MOST COMPATIBLE MATCHED COMPONENTS IN THE INDUSTRY

THE experts tell us high-fidelity equipment will net a big share of Christmas sales. Take note of this prediction now. Plan to take the biggest sales lead locally with *G-E Custom Hi-Fi.* It's customer-preferred because it brings highest quality at lowest cost! It's the best seller because it offers an impressive performance and cost edge over competition. Ideally-matched components assure finest tonal quality, longest life. Put General Electric merchandise in your window. Display it on your floor. Then reap the extra dollar volume, the extra profits.

Remember, your local retail promotion is backed by a special national campaign. Get on the bandwagon. Cash in on the ads in HOUSE BEAUTIFUL, ESQUIRE, HARPER'S, SATURDAY REVIEW, NEW YORKER, and HIGH FIDELITY. And, get ready for the Christmas rush. Order ample stocks of General Electric Hi-Fi components now!

General Electric Company, Section R9114
Electronics Park, Syracuse, New York

Send me information on all units in the G-E high-fidelity equipment line.

NAME_____

ADDRESS_____

CITY_____ STATE_____

GENERAL ELECTRIC

EICO GIVES YOU ALL THREE!

1. LOWEST PRICE

Laboratory Precision at Lowest Cost in the Industry!

2. QUALITY

EICO guarantees FINEST QUALITY COMPONENTS, checked by stringent quality control tests.

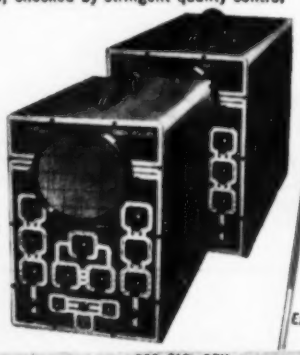
3. PERFORMANCE

EICO guarantees you can build any EICO KIT —and save 50%.

425K 5" PUSH-PULL OSCILLOSCOPE KIT $44.95 WIRED $79.95

Feature-packed, performance proven, economy-priced — an EICO exclusive! Tens of thousands in use!

- Push-pull Vert. & Hor. amplifiers.
- High V & H sens.: 0.05-0.1 rms v/in.
- V & H response: 5 cps—500 kc.
- Useful to 2.5 mc.
- Sweep: 15 cps—75 kc.
- Z-axis intensity modulation.
- Direct connections to CRT plates.
- Tubes: 2-6J5, 3-6SN7, 2-5Y3, 5" CRT.



470K 7" PUSH-PULL OSCILLOSCOPE KIT $79.95 WIRED $129.50

America's greatest big-scope value—sets a new high for sensitivity at wide bandwidth!

- Vert.: flat ±2 db 10 cps—1 mc, .01 rms v/in.
- Hor.: flat 10 cps—200 kc, —4 db at 500 kc, .3 rms v/in.
- Sweep: 15 cps—100 kc.

NEW! 232K PEAK-to-PEAK VTVM with AC/DC UNI-PROBE KIT $29.95. WIRED $49.95.

- Measures directly p-p voltage of complex & sine waves: 0-4, 14, 42, 140, 420, 1400, 4200.
- DC/RMS sine volts: 0-1.5, 5, 15, 50, 150, 500, 1500 (up to 30,000 v. with HVP probe, & 250 mc with PRF probe).
- Res.: 0.2 ohms to 1000 megs in 7 ranges.
- DC input R: 11 megs. 1% precision ceramic multipliers. 4½" meter. UNI-PROBE: Only 1 probe performs all functions—a half-turn of probe-tip selects DC or AC-OHMS! (Pat. Pend.)

320 SIG. GEN. KIT $19.95. WIRED $29.95.

- Fundamentals 150 kc to 34 mc, calibrated harmonics to 102 mc.
- Pure or modulated RF, & Colpitts oscillator 400 cps sine outputs.
- Vernier knob tuning.

322K SIG. GEN. KIT $29.95. WIRED $34.95.

- As above, plus individual calibration of each of its 5 bands.

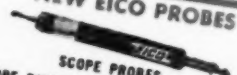
625K TUBE TESTER KIT $34.95. WIRED $49.95.

- Tests all conventional and TV tubes.
- Lever-action switches for individual testing of every element.

PIX TUBE ADAPTER for Tube Testers $4.50.

- Checks TV picture tubes while in set.

NEW EICO PROBES

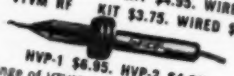


SCOPE PROBES

SCOPE DIRECT KIT $2.75. WIRED $3.95.
SCOPE DEMODULATOR KIT $3.75. WIRED $5.75.
SCOPE LOW CAPACITY KIT $3.75. WIRED $5.75.

VTVM PROBES

VTVM PEAK-TO-PEAK KIT $4.95. WIRED $6.95
VTVM RF KIT $3.75. WIRED $4.95



HVP-1 $6.95. HVP-2 $4.95.
Extends range of VTVMs & voltmeters to 30 KV.

321K VACUUM TUBE VOLTMETER KIT $29.95. WIRED $39.95.

- AC/DC volts: 0-5, 10, 100, 500, 1000 (up to 30,000 v. with HVP probe, to 250 mc with PRF probe, & peak-to-peak with PTP probe).
- Res.: 0.2 ohms to 1000 megs in 5 ranges.
- DC input R: 25 megs.
- Large 4½" meter, can't-burn-out circuit.
- 1% precision ceramic multipliers.

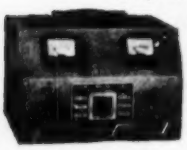
360K TV/FM SWEEP GEN. KIT $34.95. WIRED $49.95.

- Covers all VHF TV/FM channels & freqs.: 500 kc—228 mc on fundamentals.
- Continuous sweep width control, 0-30 mc.
- Crystal marker oscillator.
- Variable phasing of 60 cps output.
- Precision 5 mc & 4.5 mc crystals, $3.95 each.

606K CATHODE RAY TUBE CHECKER KIT $17.95. WIRED $24.95.

- Checks all TV picture & C.R. tubes in set or carton.
- Detects shorted & open elements.
- Measures peak beam current (proportional to screen brightness)—reading directly in terms of tube condition.

1050K 6V & 12V BATTERY ELIMINATOR & CHARGER KIT $29.95. WIRED $38.95.



- 2 DC ranges: 0-8V (10A continuous, 20A intermittent); 0-16V (6A continuous, 12A intermittent).
- Continuous voltage adjustment: variac-type transformer.
- Separate voltmeter & ammeter.

145K MULTI-SIGNAL TRACER KIT $19.95. WIRED $29.95.

- Audibly signal traces all IF, RF, video & audio from ANT to SPKR or CRT without switching.
- Germanium crystal diode response well over 200 mc.
- 5" test speaker.

147K DELUXE MULTI-SIGNAL TRACER KIT $24.95. WIRED $39.95.

565K MULTIMETER KIT $24.95. WIRED $29.95.

- 20,000 ohms/v.; 31 ranges.
- DC/AC Output volts: 0-2.5, 10, 50, 250, 1000, 5000.
- DC current: 0-100 ua; 10, 100, 500 ma; 10 A.
- Ohms: 0-2K, 200K, 20 meg.

555K MULTIMETER $29.95. WIRED $34.95.

- As above, but with 1% precision resistors.

OTHER EICO MODELS

249K Deluxe PEAK-to-PEAK VTVM with 7½" METER & UNI-PROBE (Pat. Pend.) (similar to Model 232) KIT $39.95. WIRED $59.95.

214K Deluxe VTVM with 7½" METER (Similar to Model 221) KIT. $34.95. WIRED $54.95.

488K ELECTRONIC SWITCH KIT $23.95. WIRED $39.95.

495K SCOPE VOLTAGE CALIBRATOR KIT $12.95. WIRED $17.95.

377K SINE & SQUARE WAVE AUDIO GEN. (20-200,000 cps) KIT $31.95. WIRED $49.95.

950BK R-C BRIDGE & R-C-L COMPARATOR KIT $19.95. WIRED $29.95.

1171K DECADE RESISTANCE BOX (0-99,999 ohms in 1 ohm steps, ½% accuracy) KIT $19.95. WIRED $24.95.

1180K DECADE CONDENSER BOX (100 mmf—0.111 mf in 100 mmf steps, 1% accuracy) KIT $14.95. WIRED $19.95.

1100K RTMA RESISTANCE SUBSTITUTION BOX (15 ohms to 10 megs, ±10% accuracy) KIT $5.50. WIRED $9.95.

566K 1,000 Ohms/Volt MULTIMETER (Similar to Model 536, but with 4½" Meter and 7 Output Ranges) KIT $14.90. WIRED $18.95.

556K As above, but with 1% precision resistors. KIT $16.90 WIRED $23.50.

944K FLYBACK TRANSFORMER & YOKE TESTER Kit $23.95 Wired $34.95

536K MULTIMETER KIT $12.90. WIRED $14.90

- 1000 ohms/v.; 31 ranges.
- DC/AC volts: Zero to 1, 5, 10, 50, 100, 500, 5000.
- DC/AC current: 0-1, 10 ma; 0.1, 1 A.
- Ohms: 0-500, 100 K, 1 meg

526K MULTIMETER KIT $13.90. WIRED $16.90.

- As above, but with 1% precision resistors.

315K DELUXE SIG. GEN. KIT $39.95. WIRED $59.95.

- 1% accuracy on all 7 ranges.
- Frequency: 75 kc to 150 mc.
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- Vernier anti-backlash tuning.
- VR tube stabilized power supply, fully shielded chassis.
- 400 cps modulation; provision for ext. mod.

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CHOOSING YOUR HI-FI LOUDSPEAKER

By
ABRAHAM B. COHEN
University Loudspeakers, Inc.

Fig. 1. A cone-type direct radiator plus a compression-type tweeter, horn-loaded, equals the multi-unit as shown in the photo.

What size loudspeaker should I buy? Should it be a single unit, a coaxial, or a triaxial? Answers to these and many other questions of importance to you in planning your hi-fi system are given. A similar discussion on loudspeaker enclosures will be presented next month.

THE rapidly increasing complexity of the hi-fidelity field has made the selection of equipment progressively more difficult for the layman, who simply wants a good reproducing system for his home at a price he can pay. These two articles will present the down-to-earth facts about loudspeakers, enclosures, and room acoustics.

Fortunately, the principles of loudspeakers and their applications are more readily digested than are those governing the associated electronic equipment. In discussing electronic amplifiers the layman may come across terms not related to his everyday experience: load impedance, feedback ratio, damping factor, etc. He will, in contrast, come across terms concerning loudspeakers that are thoroughly familiar. He will realize that deep bass notes must come from large speakers, for he has heard such notes from large bass fiddles and massive tubas. Likewise, he will readily accept the fact that treble notes come from diminutive loudspeakers, for again he has often heard these brilliant tones coming from small instruments like the piccolo and flute. Similarly, in the matter of room acoustics, he will feel at home, for he knows how his voice reverberates when he sings in the shower and how dead it is in his well-carpeted foyer.

The final test of any audio system lies in what the ear hears and likes. Therefore, jobbers of high-fidelity equipment have set up elaborate demonstration rooms where the buyer may judge for himself and choose what his ear likes best. For the same reason, we find audio shows organized throughout the land, especially at this time of year, which is the start of the hi-fi "season." However, it is possible to point out concrete equipment features which will govern the effects produced by it.

The focal point of any acoustic reproducing system is the loudspeaker. It doesn't matter whether the system is low- or high-fidelity, the loudspeaker —and only the loudspeaker—converts the electrical signal to an audible signal which in some measure resembles the original sound. The degree to which the reproduced sound approaches the original is a function of many factors *operating upon* the loudspeaker, as well as the quality of the loudspeaker itself. But the prime source of sound is the loudspeaker.

Loudspeakers vary in size and complexity, depending upon the application for which they are intended. It is impossible to state that one type of speaker is unconditionally better than another. The merit of one type of speaker over another must be examined in the light of the intended application. For example, if we must limit ourselves to an 8" speaker because of the space limitation of a bookshelf into which we plan to put a speaker system, that doesn't mean that an 8" speaker is better than a 15" speaker; it simply means that in this particular application the 8" speaker is preferred to the 15".

Would we then go on to say that, given the space, a 15" speaker would be better than an 8" speaker? Again the answer is not an unequivocal "yes." It is "yes, but—". The 15" speaker will produce better and deeper low frequencies than the 8" speaker, *but* will it give as good high frequencies? In all probability, no. So there we have it again: the 15" speaker is better than the 8" speaker for the *application for which it was intended*, the reproduction of low frequencies. Because of this problem of application, we find the field of loudspeakers and enclosures broken down into categories that meet *specific* applications. We find the loudspeaker market offering us low-frequency "woofer" speakers, high-frequency "tweeter" speakers, middle-range "squawker" speakers, and integrated combinations of these into "coaxial" and "triaxial" speakers. These types should be compared with each other, not on a basis of what is "better," but on a basis of what best fits a particular application or need.

Loudspeakers are of two basic types. There are "direct radiators" and there are "compression driver, horn-loaded" radiators. (Fig. 1.) A direct radiator is a loudspeaker whose diaphragm or cone faces into the room with nothing between it and the listener's ears except a grille cloth, while the rear of the loudspeaker faces into a box-like cavity with or without acoustic compensating openings. A compression-type driver unit is a loudspeaker in which the rear of the unit is tightly sealed off in a small chamber, and the front of the diaphragm plays into a

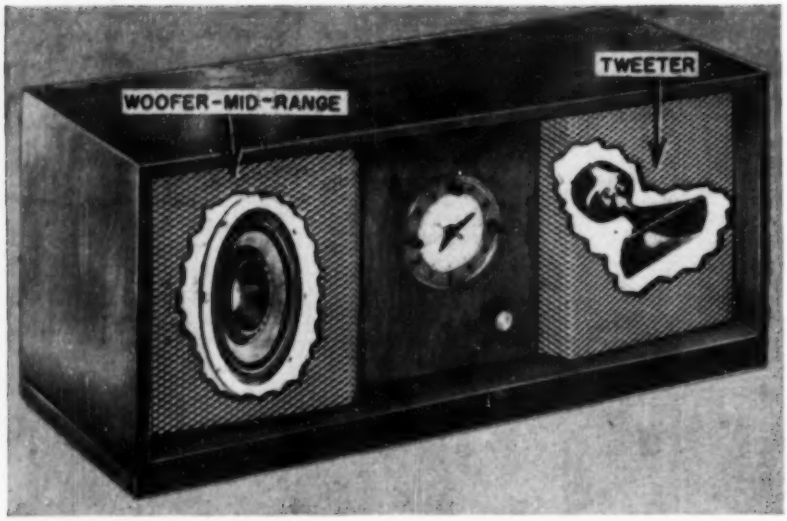


Fig. 2. With modern hi-fi cones such as the 8" cone shown in the cutaway section of its matched enclosure, the bass response is of such magnitude as to permit the use of a tweeter to make the system into a multi-speaker installation of good balance.

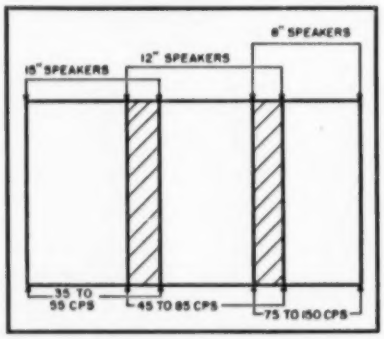
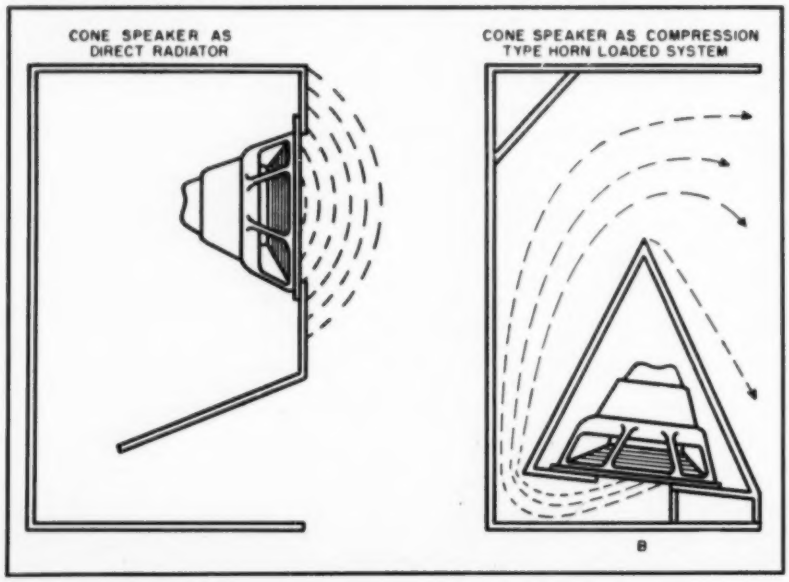


Fig. 3. Relative frequency bands in which the natural resonances of the three different loudspeaker sizes will fall. See text.

horn before the sound reaches the ear. This type of structure is usually found in tweeter (high-frequency) speakers. Here, again, there is no sharp line of demarcation between speaker types other than application. One is not necessarily better than another; they meet different applications. For that matter, a direct-radiator type of loudspeaker often is converted into a compression-type driver unit by building it into a structure of the "horn-loaded" type. (Fig. 4.)

Often these two types are combined in a single unit, such as a two-way coaxial loudspeaker, where the "woofer" section is a large cone-type direct radiator and mounted concentrically with it is the compression-type driver and horn for "tweeter" reproduction. Such a structure has certain advantages and disadvantages over separate units, again depending upon the application.

Fig. 4. A cone-type loudspeaker may be classified as a direct radiator when it is mounted in a bass reflex cabinet as shown at the left, but the same cone speaker becomes a compression-type driver when used in horn system shown at the right.



There is at least one cone-type speaker in every home audio system. If the system is a small, compact arrangement, it usually has a single speaker. If it is a very elaborate system it may have two or three cone-type speakers, and one or two compression-type, horn-loaded driver units. The most prevalent sizes of cone speakers are 8", 12", and 15". There is a good reason for this variety of sizes, just as there is a good reason for the various-sized instruments of the orchestra. Since loudspeakers *reproduce music* they must have some of the characteristics the originating instruments have. For example, we will find four sizes of stringed instruments in the modern concert orchestra: the violin, viola, cello, and bass viol. Although the frequency-producing ranges of these instruments may overlap considerably, they encompass different "bands" of notes, with successive bands reaching down into lower and lower notes. We may look upon 8", 12", and 15" speakers as *overlapping* instruments of our acoustic orchestra; in general, the 8" speaker will reproduce the highest band of tones, the 15" will reproduce the lowest band, and the 12" speaker will span the middle band.

It would be advantageous to convert these generalities to numerical figures because when we go to buy equipment, we shall come across figures that are meant to give us information as to what the speaker can do. All loudspeakers have "resonant frequencies." At its resonant frequency, a speaker will respond more readily to a signal than at any other frequency. It is generally true that the larger the loudspeaker the lower its resonant frequency. We may find that various 15" speakers on the market have resonant frequencies ranging from 35 to 55 cycles-per-second; 12" speakers may range from 45 to 85 cps; and 8" speakers from 75 to 150 cps. (Fig. 3.) What do these resonant frequencies mean in terms of listening pleasure, and in terms of system component selection? They indicate the general frequency area where a particular speaker is most efficient for a given signal input. They also show that one size of speaker is more efficient in one area than another size. To realize the maximum bass reproduction we would want to employ a 15" speaker *provided it can be accommodated within an enclosure suitable to its needs.* It is just as important to match an enclosure to the loudspeaker as it is to match the voice coil impedance of the loudspeaker to the output impedance of the amplifier.

For illustrative purposes let us go back to the bass fiddle. Those long heavy strings that are tightly stretched across the big hollow body of the instrument really resound when they are plucked or bowed be-

cause of the resonating body of the instrument itself which is "closely coupled" to the strings, both mechanically and acoustically. However, if we take this same set of strings and stretch it between two posts separated simply by thin air, the resultant sound will be equally thin. If we take our 15" speaker with its low resonance and put it into an enclosure large enough to "resonate" with the speaker in full measure, we may expect maximum listening satisfaction from the 15" speaker for the *low* frequencies. If, however, we should put this 15" speaker into a box just barely big enough to physically contain the speaker, then we will seriously impair the performance of the speaker. Putting the speaker into extremely close confines literally tightens the air cushion around the speaker and *raises* its resonant frequency. If we have bought a loudspeaker because of its low resonant frequency and then operate it in an unsuitable enclosure, we have thrown away our money.

Suppose, however, that to fit our pocketbook we must limit ourselves to an 8" speaker. Starting with an 8" speaker is not the worst thing in the world, for there are some fine hi-fi speakers in this size as we shall soon see. Furthermore, after one has started his system with a good quality 8" speaker, he may use it as a springboard to a more complex system as his hi-fi experience grows. Having started with an 8" speaker with a high resonance, what may we expect of it in listening returns? When we state that an 8" speaker has a resonance of 90 cps, we don't mean that the speaker doesn't respond to anything below that frequency. This figure represents the frequency at which the speaker vibrates most freely; it definitely vibrates *below* this frequency, but with the amplitude reduced approximately 12 db per octave. Even though it is most efficient at 90 cps, it will respond to a signal of 45 cps, but with approximately 12 db less output.

Getting down to actual musical enjoyment, what do we lose in the case of the smaller speaker? The *lowest* note on the piano is approximately 26 cps, on a bass viol, 40 cps, on the cello,

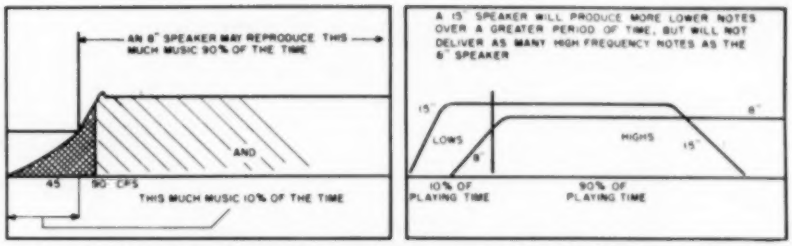

AN 8" SPEAKER MAY REPRODUCE THIS MUCH MUSIC 90% OF THE TIME
AND
45
90 CPS
THIS MUCH MUSIC 10% OF THE TIME
A 15" SPEAKER WILL PRODUCE MORE LOWER NOTES OVER A GREATER PERIOD OF TIME, BUT WILL NOT DELIVER AS MANY HIGH FREQUENCY NOTES AS THE 8" SPEAKER
15"
8"
LOWS
8"
HIGHS
15"
10% OF PLAYING TIME
90% OF PLAYING TIME

Fig. 5. Although an 8" speaker may have more restricted low-frequency response than a 15" unit, it will produce relatively full musical output most of the time.

64 cycles, on the bass tuba, 60 cps. We emphasize the word *lowest*. These are not "Johnny-one-note" type of instruments; they don't play only their lowest note. They may hit it once in a while, but in the main the music they make is much higher in frequency. Thus, *when and if*, low bass fiddle notes happen to come along the 8" speaker will deliver them with enough level to present the feeling that the bass is there. On the other hand, the 15" speaker will take these low notes in its stride. There will be more lows—and better lows—with the 15" speaker than with the 8" speaker, *when and if* those low notes are present. If, however, we can continue to enjoy life with say, 90% of the music available, the higher resonance 8" speaker will do an admirable job. (Fig. 5.)

Do we necessarily want as low a resonant frequency as possible? The answer is no. Suppose we were building a small bookshelf enclosure (Fig. 2) to take an 8" speaker. Assuming an 8" speaker with a resonance of 50 cps were available, let us compare the results of this speaker with one of 100 cps resonance. First, the 50 cps speaker would normally have more output in the 50 cps region than the 100 cps speaker, provided it were perfectly free to vibrate. But it is not free to vibrate because it is damped by the small air chamber of the enclosure. It doesn't produce its full output at 50 cps. However, it still may be a little better than the 100 cps speaker output. But there is a second factor. There is usually a drop in energy immediately above the resonant point of a speaker (Fig. 6), and the lower this resonant frequency, the greater is the valley after it. Thus we can get good lows, but sacrifice somewhat immediately above the resonant frequency. Which shall we pick? *Good low lows* and *mediocre upper lows*, by choosing a very low resonant frequency unit, or shall we have *fair low lows* and *good upper lows* by choosing a higher resonance unit? It is purely a listener's preference. From the first speaker he will get a little better *low bass*. From the second speaker he will get a little less low bass, but *more total music*.

Although an 8" speaker may not deliver the low frequencies that the 15" speaker will produce, it is superior for high frequencies. Its small size and lighter moving system make it a more efficient high-frequency radiator. Consequently, whereas a single elementary 15" speaker serves only the restricted purpose of producing low frequencies, we may obtain very acceptable *total* music reproduction from a single 8" speaker.

This then brings us to the problem of single "wide-range" speakers as compared to specialized speakers for bass, mid-range, and treble applications. If we wish to start with a single speaker, we will have to select one which gives as broad a frequency response as possible. It will be a "wide-range," or "extended-range" speaker, of the direct-radiator type, and either 8" or 12", for in these two sizes it is possible to obtain a reasonable response in both the treble and bass regions. (Fig. 7.) An 8" speaker usually will have better highs than a 12", whereas a 12" will have better lows. The choice of speaker will, of course,

Fig. 6. The "natural resonance" of the speaker simply determines over what portion of the musical spectrum the speaker will operate to best advantage but it will not indicate that it is better or worse than another resonance in a different speaker.

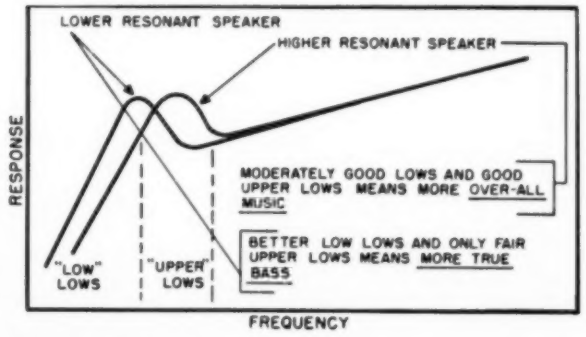
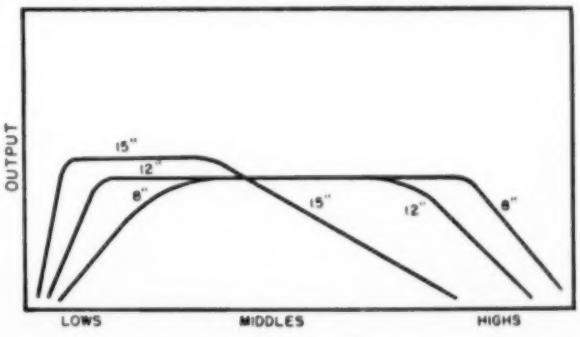

LOWER RESONANT SPEAKER
HIGHER RESONANT SPEAKER
RESPONSE
MODERATELY GOOD LOWS AND GOOD UPPER LOWS MEANS MORE OVER-ALL MUSIC
BETTER LOW LOWS AND ONLY FAIR UPPER LOWS MEANS MORE TRUE BASS
"LOW" LOWS
"UPPER" LOWS
FREQUENCY

Fig. 7. For single-speaker operation, the 8-inch and 12-inch loudspeakers will provide good frequency bandspread. The 15-inch loudspeaker will, as indicated on the graph, fall off rapidly at the high end of the frequency spectrum. See text.



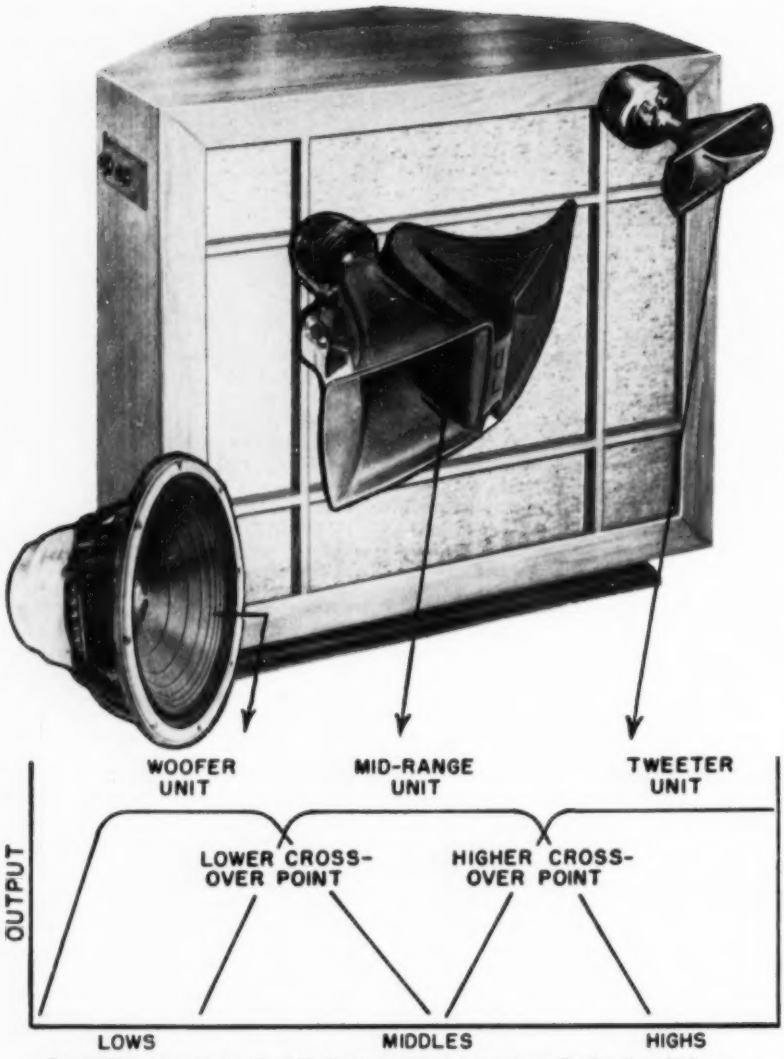


Fig. 8. The components of a hi-fi three-way system are specialized units which are designed to operate most efficiently within the band in which they are to be used.

depend on the enclosure size available. The simple 15" speaker is out of the running as a single-purpose, wide-range speaker because of its limited high-frequency response.

These "basic wide-range speakers" usually are low in price and perform quite satisfactorily when properly used. After a wide-range speaker has been used for some time, it may become the pivot point for future expansion of the system. However, simple single-speaker systems do have definite limitations, and although they do provide considerable listening pleasure, there are several modifications that raise the degree of fidelity of which they are capable. Most of the improvements in general wide-range speakers have been made toward stepping up high-frequency performance and minimizing intermodulation distortion.

What may we do to a simple loudspeaker to improve its high-frequency response? For one thing we could make it more efficient so that for the high-frequency electrical energy we feed into it, we get more acoustic output. Secondly, we might do something to the structure to spread out the high frequencies over a wider angle. The high frequencies that come out of the simple cone-type of speaker tend to concentrate in a relatively narrow beam while the lows spread out quite readily. The result is that there is a loss of high-frequency sound for the listener sitting off to the side of the speaker. Something can be done to the cone structure to break up the beaming of the highs and spread them out more uniformly over the room. Speakers designed to accomplish this purpose can be recognized by the diffraction or diffusicone elements located within the apex area of the cone. (Fig. 1.) These devices spread out the otherwise tightly beamed sound energy.

These elements are added to the apex of the cone in such a manner that the body of the cone "uncouples" itself from the apex area when the cone is vibrating with high-frequency energy. This is called a "mechanical crossover"; it is a means of converting a single voice coil and cone assembly into a "two-way" system. When energized by low frequencies, the cone as a whole moves. When energized by high frequencies, only the center section and the diffraction elements move. Not only is such a two-way system a better dispersion agent for the highs, but it increases the efficiency of the speaker in the treble region as well, because of the uncoupling of the comparatively massive cone. Thus, such a two-way system is an improvement on the "wide-range speaker" of the same size because of the wider "fidelity angle," the increased high-frequency efficiency, and the minimizing of intermodulation between woofer and tweeter sections of the diaphragm.

(*Continued on page* 134)

Fig. 9. A good two-way system can be made by adding a tweeter and crossover network to an existing wide-range loudspeaker.

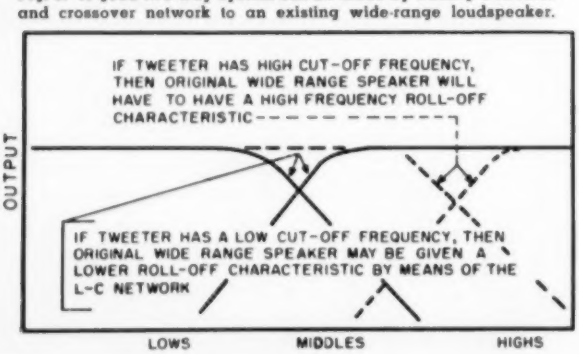
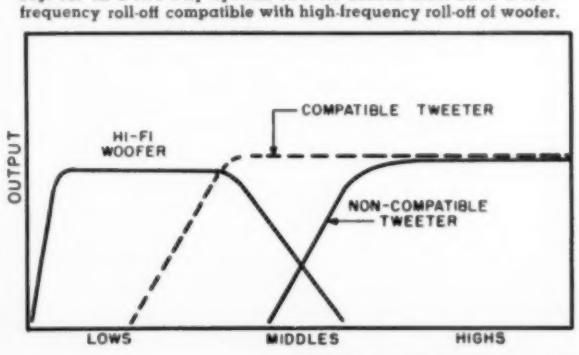
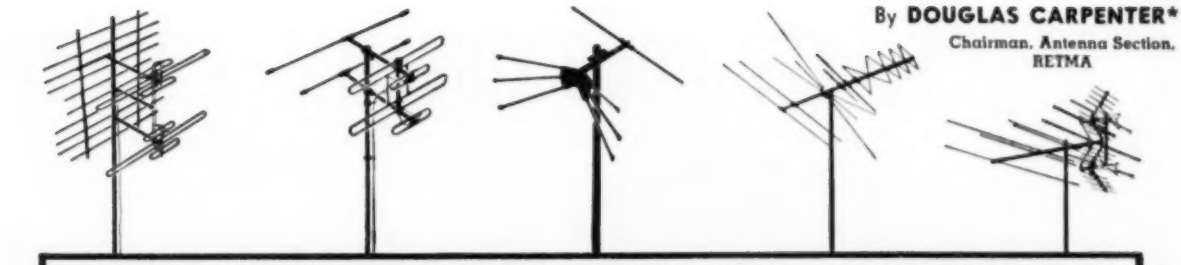

IF TWEETER HAS HIGH CUT-OFF FREQUENCY, THEN ORIGINAL WIDE RANGE SPEAKER WILL HAVE TO HAVE A HIGH FREQUENCY ROLL-OFF CHARACTERISTIC
OUTPUT
IF TWEETER HAS A LOW CUT-OFF FREQUENCY, THEN ORIGINAL WIDE RANGE SPEAKER MAY BE GIVEN A LOWER ROLL-OFF CHARACTERISTIC BY MEANS OF THE L-C NETWORK
LOWS
MIDDLES
HIGHS

Fig. 10. In a two-way system, tweeter chosen must have a low-frequency roll-off compatible with high-frequency roll-off of woofer.



By **DOUGLAS CARPENTER***
Chairman, Antenna Section, RETMA



NEW STANDARDS FOR TV ANTENNAS

The RETMA Antenna Section is currently contemplating the adoption of a new method of rating TV antennas. This will avoid misleading and meaningless claims.

THE most common yardstick today for evaluating the performance of TV antennas is db gain. As a matter of fact, however, even this unit of antenna measurement has lost its significance.

In the early days of TV, only pentode tubes were used in the r.f. amplifier portion of the TV tuner. Considerable gain was realized, but the limiting factor of the usable signal was the amount of noise generated in the first amplifier stage. The weak signal had to override this fixed noise level, otherwise there was too much "snow" in the picture after amplification.

In succeeding designs, attempts were made to decrease the amount of interfering noise generated by the amplifier stage rather than increase the gain available from this stage. This led to the triode-cascode circuit.

The same type of treatment is applicable to some extent to the TV antenna, and the common denominator of antenna performance can be rightly called signal-to-noise ratio. There are several factors that enter into the ability of the antenna to deliver maximum signal with minimum amplified noise. In order of importance they may be listed as: horizontal polar pattern, front-to-back and side ratio, terminating impedance, gain, and vertical polar pattern. These five basic characteristics for any antenna must be considered as a whole.

As transmitted video signals are horizontally polarized, the response in this plane is the critical consideration. The horizontal pattern keynotes the general performance to be expected from the antenna and establishes, to a great degree, the ratio of signal-to-noise that can be realized.

The amount of noise which will be passed along to the receiver is composed of two parts. The first is termed thermal agitation, and is due to the random movement of electrons in the antenna conductors and transmission line. This type of noise is fixed for a particular antenna and exists across the entire frequency spectrum. The second source of noise might be termed man-made, and is composed of varying electrical disturbances from machinery, lighting equipment, etc. as well as atmospheric disturbances. These noise signals come to the antenna from all directions.

The horizontal pattern of an antenna tells us the number of degrees around the antenna over which a signal will be received and passed on to a set with satisfactory strength. The wider the lobe, the greater the noise received along with the desired signal. Fig. 1 shows the standard folded dipole horizontal pattern with a beamwidth of 50 degrees, and the pattern of an ideal antenna with a beamwidth of 10 degrees. The response of a test antenna is also included. This test antenna has a beamwidth of 18 degrees at the 6 db points.

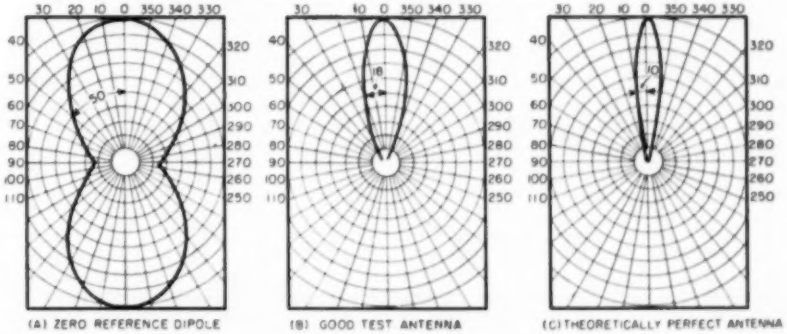
It was mentioned previously that there are five important characteris-

(*Continued on page* 132)

ANTENNA CHARACTERISTIC	DIPOLE REFERENCE LEVEL	OPTIMUM THEORETICAL LEVEL	MAXIMUM RATING
Horizontal polar pattern	50 degrees	10 degrees	20%
Front-to-back & front-to-side ratio	0 db	20 db	20%
Terminating impedance ratio	1.5/1	1/1	20%
Gain	0 db	20 db	20%
Vertical polar pattern	0 db	10 db rejection	20%
Theoretically perfect signal-to-noise rating			100%

Table 1. List of the important antenna characteristics discussed in this article with the optimum and reference levels used with each for rating purposes.

Fig. 1. Polar diagrams comparing the horizontal beamwidth of a half-wave folded dipole (A) to the beamwidth of a test antenna (B) and an ideal antenna (C).

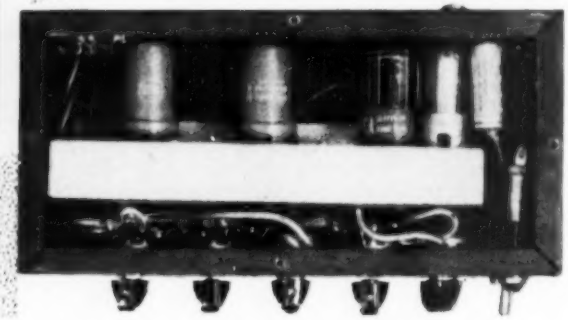


(A) ZERO REFERENCE DIPOLE (B) GOOD TEST ANTENNA (C) THEORETICALLY PERFECT ANTENNA

* Chief Engineer, Antenna Division, JFD Manufacturing Co., Inc.

A SIMPLE—YET GOOD QUALITY—PREAMP

Front and bottom views of the assembled preamplifier. The chassis measures a mere 5" x 10" x 3" over-all.



By ALEXANDER FINLAY
Battelle Memorial Institute

Details on a well designed unit for use with magnetic pickups. Amplification of 46 db is provided in preamp.

THE preamplifier in a modern high-fidelity installation is called upon to perform several very important tasks. It is required to supply the amplifying system with most of its voltage gain. It is required to supply the proper gain *vs* frequency characteristics of the program material, and it must act as the control center for the entire high-fidelity system.

The usual power amplifier in use today requires about one to two volts input for full output. The usual magnetic transducer or pickup used in these installations has an output which may be as low as ten millivolts. This means that in order to be suitable for use with any of the popular types of magnetic pickups, an amplification of about 46 db or 200-to-1 is required from the preamplifier.

The gain *vs* frequency characteristic of the preamplifier must complement the output *vs* frequency characteristic of the record and magnetic pickup combination. The usual practice is to record in such a way that the output from a magnetic pickup is proportional to frequency from the lowest recorded frequency to a frequency of about 500 or 800 cycles. The output of the pickup is normally constant with respect to frequency from 500 or 800 cycles to a frequency of about 1590 or 2500 cycles. Above 1590 to 2500 cycles the output from the magnetic pickup is again proportional to frequency. The equalization system of the preamplifier must be such that the over-all frequency response from record to power amplifier input is flat or constant throughout the audible frequencies.

In order to accomplish the desired result, the preamplifier must have a gain inversely proportional to frequency from below audible frequencies to 500 or 800 cycles (turnover frequency). The gain must be constant from the turnover frequency to 1590 or 2500 cycles (roll-off frequency). Above the roll-off frequency, the gain must once again be inversely proportional to frequency. In order to carry the proper compensation to frequencies below audibility from a turnover point of 800 cycles, for example, a total increase in amplification of about 40 db is required. This amplification plus the over-all gain necessary means that a total amplification of 86 db will be required of the amplifier. The compensation above the roll-off frequency requires a reduction in gain, usually of 6 db per octave but sometimes of 2.5 or 3 db per octave. Thus, high-frequency compensation has no effect on the amplification requirements.

The fact that the preamplifier is the control center makes a small, attractively designed unit very desirable. The unit must have sufficient flexibility to cope with the several recording curves in use today. The ability to operate properly, even though a considerable distance from the remainder of the amplifying system, is a definite advantage.

Electrical Design

There are, of course, many combinations of elements which will produce the required gain. The compensating system can be designed in a number of ways. However, designing the low-frequency compensation into the feedback loop of an inverse-feedback amplifier has the advantage of improving the performance of the amplifier without any disadvantage, such as a requirement for a higher-gain circuit when compared to the "losser" type of equalization system. When this system of compensation is used it does, however, become necessary to be somewhat careful of the design as anyone who has attempted a similar unit can no doubt attest. Without careful design instability will undoubtedly exist, particularly when as much as 40 db of feedback is applied around more than one stage of amplification.

In order to allow sufficient gain while keeping the number of stages to a minimum, type 6SJ7 tubes were chosen. This allows the necessary 86 db of amplification to be obtained in only two stages. The use of triodes would require at least three stages for the same amplification. The problem of applying the feedback around such a three-stage amplifier would be a much more difficult one than with the pentodes.

The 6SJ7 pentodes are connected in the usual manner except that the cathode bias resistances are quite low. This makes it possible to eliminate cathode bypass condensers without an excessive amount of current feedback and also minimizes the possibility of hum trouble due to the unbypassed cathodes. In addition, the bias is quite low and allows the maximum transconductance to be realized from the tubes.

One of the most common failings of amplifiers of this type is the method of applying the feedback loop. In the normal case the impedance of the feedback loop is a small fraction of the impedance of the plate load of a pentode amplifier. If the feedback loop is connected directly to the plate of a pentode, part of the gain reduction is due to loading of this plate circuit rather than negative feedback. This difficulty has been avoided by taking the feedback from the output of a cathode follower which is driven by the second 6SJ7. This cathode fol-

lower input is modified to produce high input impedance in order to minimize phase shift which would cause low-frequency instability.

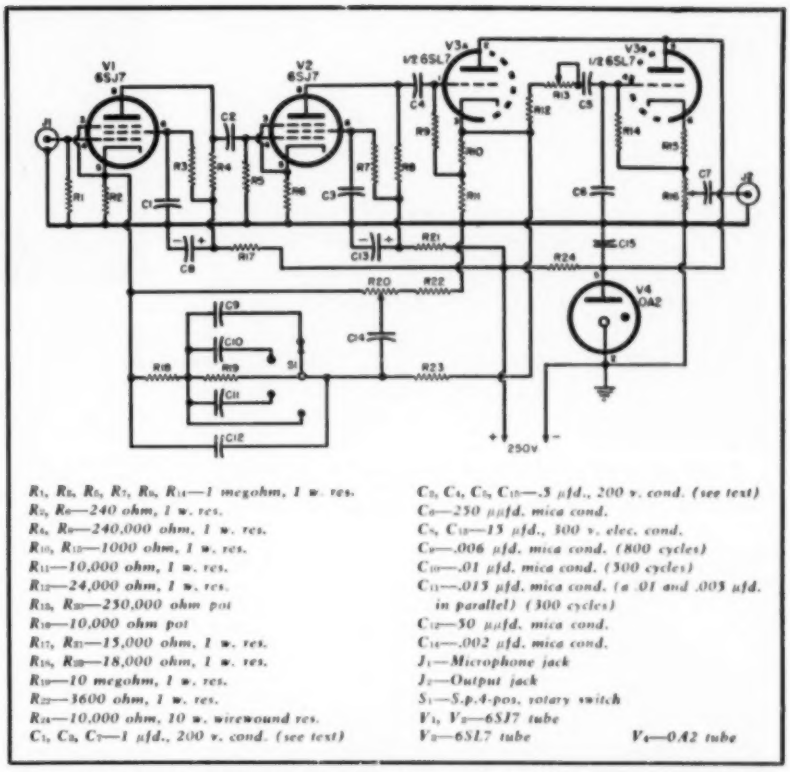
The original amplifier built along these lines achieved high-frequency compensation by the simple and well-known method of loading the magnetic pickup with resistance. While this method is simple and works well with pickups which have a resistance which is low compared to the reactance of the unit at the roll-off frequency, it has the disadvantage of being suitable for only one type of pickup. Later models have incorporated a type of high-frequency compensation which does not depend on the type of pickup used. This is accomplished by R_{12} and C_6 as shown in the circuit diagram. R_{12} can be made continuously variable to give complete control of the roll-off frequency or can be a step adjustment. In the latter case R_{12} plus R_{13} should be equal to $1/2\pi f_r C_6$ where f_r is the roll-off frequency. Different R_{13} values can then be selected with a switch to give the desired roll-off frequencies.

A second cathode follower is used to provide a low-impedance output system which allows the preamplifier to be remotely located with respect to the power amplifier without any detrimental effects on the frequency response. The two cathode followers cause a reduction in voltage gain of about 3 db which is not serious since the over-all gain is still about 43 db.

The combination R_{20}, R_{22}, and C_{14} allows an adjustment of the high-frequency response. With R_{20} in midposition no modification of high-frequency response exists. At one extreme of R_{20}, half of the feedback loop is shunted by C_{14}. This results in a 6 db reduction of the frequencies above about 6000 cycles. The other extreme of R_{20} bypasses the center of the feedback loop to ground and results in an increase of amplification above about 4000 cycles. With R_{20} in this position, the gain increases to a value determined by the resistance of R_{22}. At intermediate settings of R_{20} about the midpoint, modifications of the frequency response less than that produced at the extremes will be obtained. This control in conjunction with the roll-off control can be used to approximate 2.5 and 3 db rates of attenuation above the roll-off frequency as shown in the plot of frequency vs amplification.

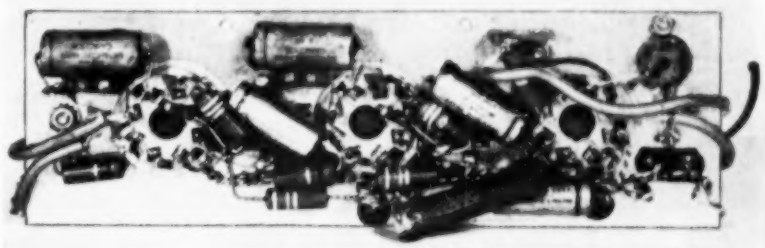
In any amplifier which has high gain at low frequencies, the problem of making the internal impedance of the power supply low enough so that low-frequency oscillation or "motorboating" does not occur is a serious one. In this instance it was necessary to use a voltage-regulator tube to isolate the cathode-follower plate circuits from the rest of the amplifier. By the same token, care must be exercised when utilizing the main amplifier-power supply to supply power to the preamplifier. This can be done but considerable decoupling must be employed in order to avoid low-frequency

(*Continued on page* 115)



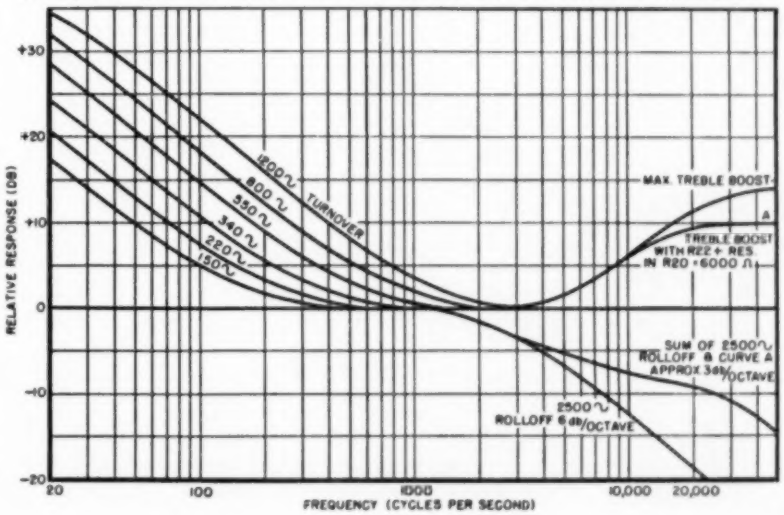
R_1, R_3, R_5, R_7, R_9, R_{11}—1 megohm, 1 w. res.
R_2, R_6—240 ohm, 1 w. res.
R_4, R_8—240,000 ohm, 1 w. res.
R_{10}, R_{13}—1000 ohm, 1 w. res.
R_{14}—10,000 ohm, 1 w. res.
R_{12}—24,000 ohm, 1 w. res.
R_{15}, R_{20}—250,000 ohm pot
R_{16}—10,000 ohm pot
R_{17}, R_{21}—15,000 ohm, 1 w. res.
R_{18}, R_{22}—18,000 ohm, 1 w. res.
R_{19}—10 megohm, 1 w. res.
R_{23}—3600 ohm, 1 w. res.
R_{24}—10,000 ohm, 10 w. wirewound res.
C_1, C_3, C_7—1 μfd., 200 v. cond. (see text)
C_2, C_4, C_5, C_{13}—.5 μfd., 200 v. cond. (see text)
C_6—250 μμfd. mica cond.
C_8, C_{15}—15 μfd., 300 v. elec. cond.
C_9—.006 μfd. mica cond. (800 cycles)
C_{10}—.01 μfd. mica cond. (500 cycles)
C_{11}—.015 μfd. mica cond. (a .01 and .005 μfd. in parallel) (300 cycles)
C_{12}—50 μμfd. mica cond.
C_{14}—.002 μfd. mica cond.
J_1—Microphone jack
J_2—Output jack
S_1—S.p.4-pos. rotary switch
V_1, V_2—6SJ7 tube
V_3—6SL7 tube
V_4—0A2 tube

Complete schematic covering a preamplifier designed to be used with magnetic pickups.

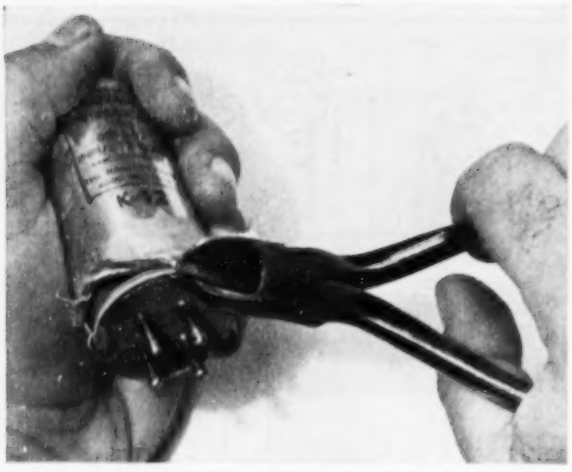


The amplifier section was constructed on an "L"-shaped aluminum bracket with shield.

Preamplifier equalization curves. See text for discussion of measurement procedures.



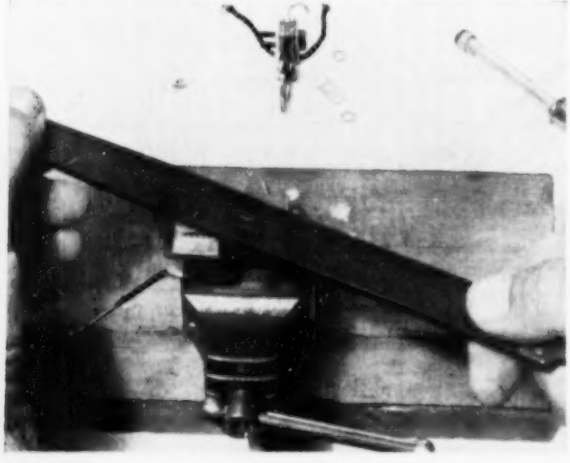
JUNK BOX "SENDING IRON"



1 To disassemble vibrator, attack bottom joint of can with diagonal pliers. Pull the terminal disc and vibrator will then slide out of the can. Remove rubber cushion and clip all wires.

2 Remove the stack of contactors from the frame, taking care not to bend or damage the reed and contacts. This will leave only the electromagnet attached to the frame of the vibrator.

3 The core of electromagnet is riveted into slot at end of the frame. File protruding upset metal flush with frame then, using a punch or screwdriver, knock magnet core out of frame slot.



AFTER making code for a while with one of Samuel Morse's pump handles, most operators begin to see the sense of having an automatic chopper. But there is the usual trouble—"Mr. Vibro" wants quite a few bucks for his "Plex," and the modern home-brewed bug has evolved into a frightening basket full of tubes, relays, resistors, and whatnot.

Here is a sending iron straight from the junk box that cuts the nicest Morse ever heard. With it, you can send from 10 wpm up to 40—if you have it in you. How many tubes? None. Relays? Likewise. At most, the average ham may have to scrape up as much as two-bits for parts, and spend a little time. The kind of work entailed, moreover, is just the kind to develop a little tool-skill.

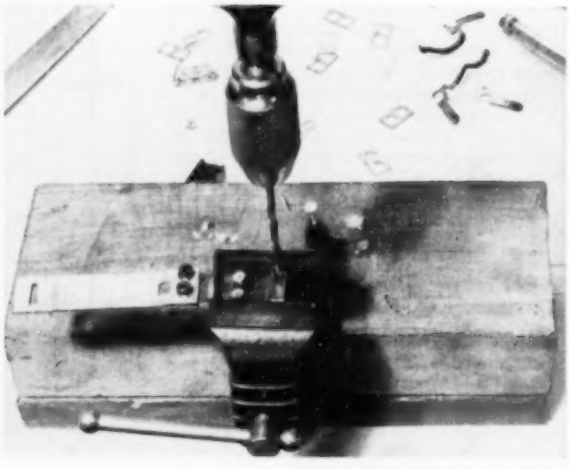
The heart of the mechanical bug is made up of the reed, the control arm, the pendulum which governs the speed of the dots, and the contacts. These parts can be found in the junk box of any shop servicing portable, marine, or mobile radio. All that has to be dug up is a burned-out vibrator. The one used in the bug pictured is a *Radiart* non-synchronous. While others may be used just as well, the least departure from these plans will be required with a vibrator of this type or one close to it.

First, tear the vibrator to pieces. Keep track of the main frame, the reed, and the contacts. Everything else can get lost.

Remove the coil, then hammer the "L" bend out of the frame, making it a flat piece of steel with a slight "jog" on the end which held the reed and contact pile-up. Take pains to get this piece perfectly flat, then file or sand off any scars. This operation has changed the vibrator "frame" into a sending-iron "lever," and it will henceforth be so called.

Now fasten the reed back onto the lever, but in the opposite direction it first took, so it extends out instead of doubling back. Put the side of the reed with the best contacts on the side of the lever which jogs out-

4 The bug lever takes shape as vibrator reed is screwed back on. Reed is on opposite side and points in opposite direction from original position. Side with the best contacts should be upward.



By **ELBERT ROBBERSON**

A burned-out vibrator and twenty-five cents' worth of small parts will make this "bug".

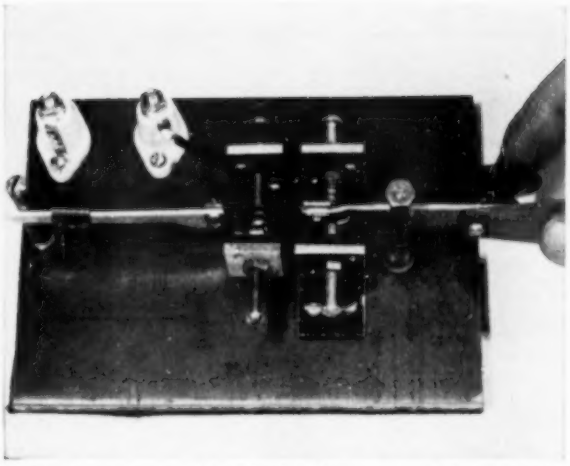
ward, because this is going to be the "dot" side, and it takes most of the punishment.

At the end of the reed will be found a little iron weight, which is called the counterweight. This must come off. An aluminum pendulum is made according to plan and secured in place of the counterweight. Be careful to keep the pendulum in perfect alignment with the reed and lever. Holes are next drilled and tapped on the end of the lever for the paddle and knob. For a little relief from the metalwork, a paddle may be cut according to the pattern from a scrap of Bakelite, a poker chip, or a section of beef-rib. Bone or ivory is esteemed highly because of the patina that comes after a few hundred hours of careful massage.

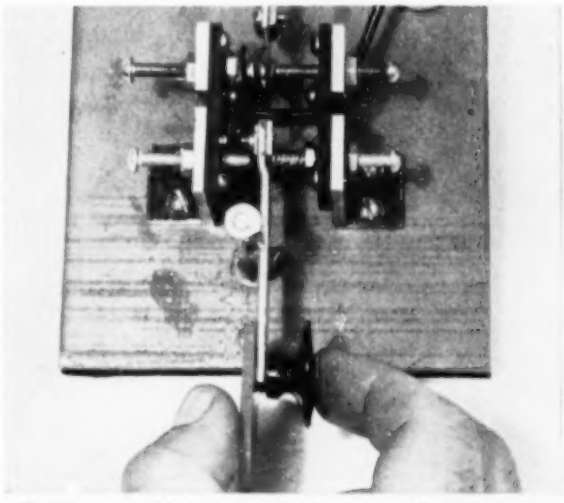
Incidentally, until you have 35-wpm hours behind you, don't fool with greatly different kinds of handles—professional operators find the combination of key-knob and paddle most comfortable and positive in action.

Before this part of the bug is finished, the main bearing must be fabricated. This is made of a two-inch length of ¼" copper tubing, which must be straight and free from kinks and dents. If not already absolutely true, it may be made so by forcing into it the shank of a #13 drill, then rolling the tubing on a hard smooth surface under pressure from a block of wood. Then repeat with a piece of 5/16" rod until the tubing will turn freely on the rod.

Place the tubing across the lever, square it carefully, and make sure the placement follows the dimensions given. Then clamp the pieces together with a small C-clamp. The C-clamp can then be gripped in a vise, and the tubing soldered to the lever.

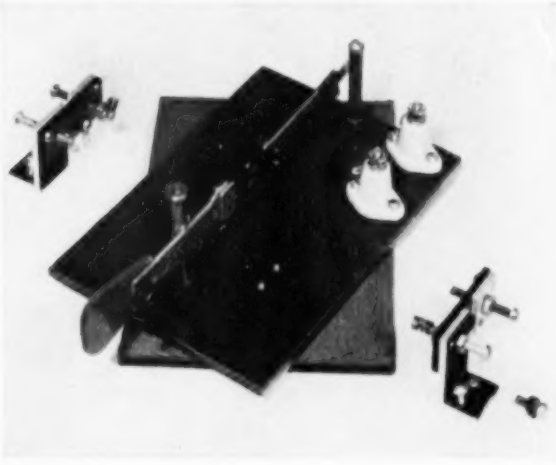


8 Quarter-ounce strip of lead folded over pendulum controls the speed of dots and should be squeezed together to prevent shifting. Start with your hand-key speed and gradually work up.

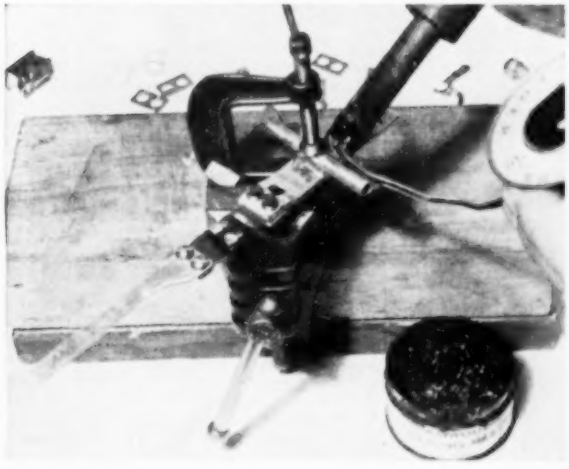


7 When assembled, wired, and adjusted, bug should line up as shown. Screws at left control dots, spring and screws at the right set "at rest" position and govern the swing of dashes.

6 After fabricating parts, assembly begins. Note how dot contact is soldered to end of adjusting screw and position of the lever main-spring is coiled around the pivot and bearing.

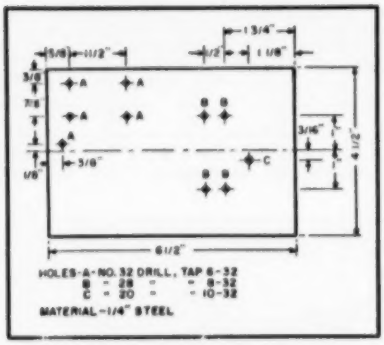


5 To solder bearing to lever, first join two pieces with a C-clamp. Use plenty of soldering paste, a generous dab on each side of bearing, then flow on the solder with a very hot iron.

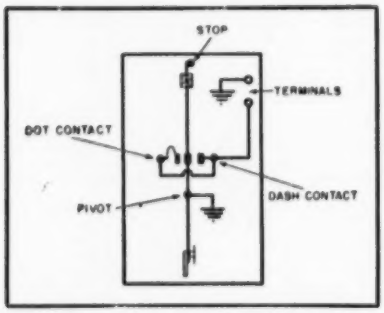


1—*Burned out vibrator*
1—*Steel plate, ¼"x6½"x4½"*
1—*Sponge rubber pad, ¼"x6½"x4½"*
1—*Aluminum channel, ⅛"x¾"x1¾"x2" long*
1—*Copper tubing, ¼"x2" long*
1—*Aluminum sheet, 1/16"x⅜"x3"*
1—*Steel drill rod, 3/16", threaded 10-32 for ¼" each end*
1—*10-32 steel hex nut*
4—*8-32 round-head brass machine screws, 1¼" long*
6—*8-32 brass hex nuts*
2—*Dial springs (see text)*
1—*Flat lead strip, ¼ ounce*
1—*Lead tubing, ¼"x1¼" long*
1—*6-32 round-head brass machine screws, 2" long*
9—*6-32 brass hex nuts*
4—*8-32 round-head brass machine screws, ½" long*
4—*6-32 round-head brass machine screws, ½" long*
1—*Bakelite strip, ⅛"x2"x3"*
1—*Telegraph-key knob*
2—*Standoff insulators (Birnbach #963)*
3—*#6 soldering lugs*
9—*6-32 round-head brass machine screws, ¼" long*

Raid your junk box for most of these parts needed to build the "sending iron."



Mechanical details for laying out the base. Base material must be heavy.



Complete schematic of "sending iron."

Attention should now be given to the layout of the base plate. The plate may be of steel, although almost any other metal that can be found will serve. Brass would work nicely and look like a million as long as it was kept polished and lacquered. On the other hand, I once made quite a serviceable bug using for a base a slab of zinc of the type attached by shipyards to hulls for electrolysis diversion. The main requisites of the base are (1) weight, and (2) workability. Have this piece of metal cut to size with a power saw, if possible, then smooth and bevel the edges with a file.

Draw the layout full size on paper, then gum the paper to the blank plate and center-punch the hole locations through the paper. This is much superior to trying to measure and mark on a piece of slick metal.

Three size drills, #32, #28, and #20, will be needed, as well as an electric or hand drill and some cu ng oil. Make the holes perpendicular, or the bug will be sloppy. Then take in hand a tap-wrench and start to work, threading the holes as specified.

For some reason, few hams ever have a tap wrench. If you are guilty, break down. They are not expensive—dime stores now carry wrenches, taps, and dies good enough for any light work. And there is nothing that makes for slicker construction than the ability to thread holes for fastening parts together. Take it slowly, use oil, back off when the tap snags, and go twice as slowly on the last hole—it is usually this one that breaks the tap.

With a knife, file, or sandpaper knock off any burrs, and the base is ready to receive the works.

Two brackets for holding the lever stops and contactors are cut from ¾" by 1¾" channel stock. Aluminum channel is easiest to work, although brass or steel will do just as well. One leg of the channel is sawed off, making the L-shaped brackets. The small pieces sawed off are squared up, then drilled and tapped for contact bearing plates which are held to the brackets by two strips of Bakelite. Here the quality of the marking and drilling shows up—if everything fits together smoothly, to the head of the class with you!

The lever stops and contactors are ordinary brass 8-32 by 1¼" machine screws, with nuts to lock them in position. Take the best of the stationary contacts remaining from the vibrator, and bend it with long-nose pliers into a very flat "U" shape, with the contacting face out. Solder this to the end of the bug's stationary-dot contact screw. The stationary-dash contact is less critical, and the bare end of the brass screw will serve well enough, although one of the remaining contact points may be removed from its little reed and soldered to the end of the screw, if desired.

The dash-stop screw also requires special treatment. Note that a nut is put on both sides of the bracket holding this screw. On the end which will be next to the lever, slip a 5/16" length of ¼" diameter spring of medium stiffness. This spring, and the main lever spring, (to be put in later) can be cut from a radio dial-cord spring found in an average assortment.

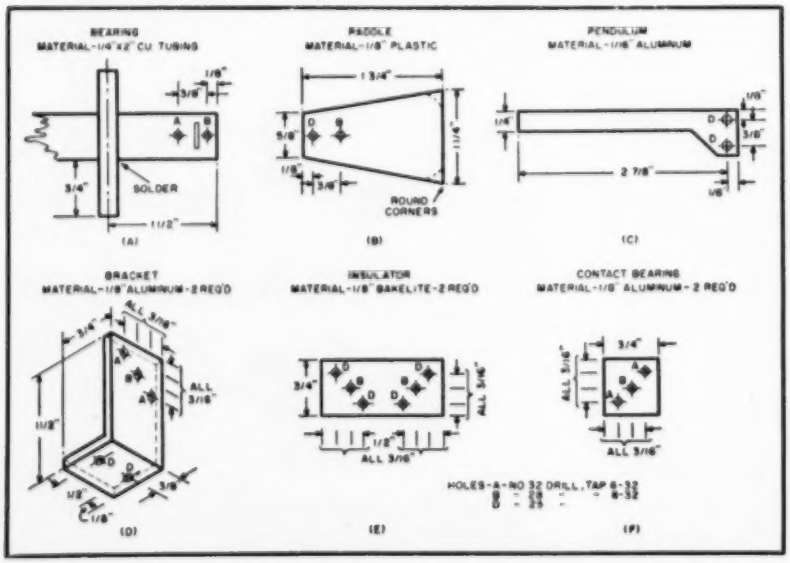
The pendulum stop, out at the back of the base, is a piece of lead tubing, than which there is practically nothing less bouncy. It is held loosely by a long 6-32 screw. Although the screw must be made solid to the base with the locking nut, the lead tubing should be free to turn or recoil as the pendulum strikes it, since this will further kill any bounce at the end of a dot cycle. A piece of lead-covered wire furnished its jacket for this piece, although there are any number of other sources the resourceful ham will find.

A pair of small stand-off insulators are used for terminals, and connections are made as shown in the diagram.

The pivot is a 2½" length of 3/16" steel drill rod. Although aluminum, brass, or other softer metals will serve in all of the other places, the pivot must be hard steel. The most bug-shy aesthete on the air will be amazed to find out how much punishment the pivot takes from his most timorous tapping. After the pivot is

(*Continued on page* 90)

Mechanical drawings covering the various small parts needed in construction.



THE PRACTICAL SWITCHLESS INTERCOM

By
RICHARD H. DORF
Audio Consultant

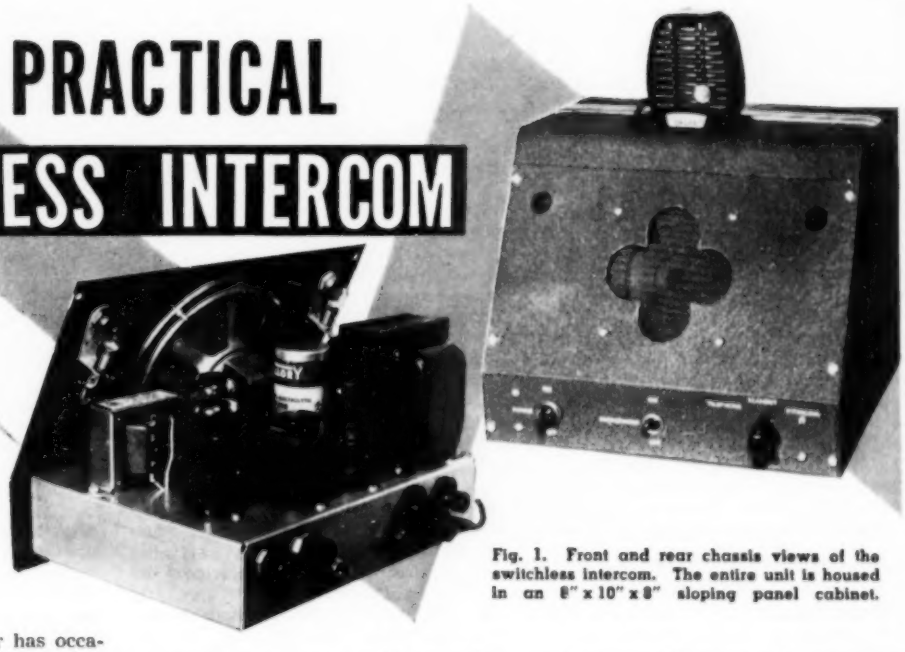


Fig. 1. Front and rear chassis views of the switchless intercom. The entire unit is housed in an 8" x 10" x 8" sloping panel cabinet.

A novel unit using three tubes and a rectifier which operates both as an intercom and a telephone amplifier. No switching is required and both parties may be heard simultaneously, if desired.

EACH MONTH the writer has occasion to look through a fair number of specifications on new patents in the electronics field. Most are of little interest to any one individual or to most people interested in electronics. Others are useful for this purpose and that. But every now and then an idea comes along in a patent that just begs to be tried out on the laboratory bench, whether or not there is a real need for the device. Sometimes that is because it does something new and interesting, sometimes just because it is so easy to put together, and sometimes for no explainable reason at all except for the writer's curiosity.

Such a patent was the switchless telephone amplifier and intercom invented by Keith S. Stanbury of Christchurch, N. Z., and issued recently as patent No. 2,655,557.

It seemed like an excellent and elegantly simple principle—solving a very old problem. We took it into the lab, assigned values, breadboarded a haywire model, trimmed values, then built up the set shown in Fig. 1. It works just as well as promised.

What Is It?

The switchless intercom set is unusual first in that it is used both as part of an intercom system and as a part of the telephone system. In both cases it allows the user to both talk and listen (simultaneously if it happens that way) without the usual necessity for holding down a key or switch while talking and releasing it to listen.

For those who have never considered this problem before it may not be immediately apparent why a "talk-listen" key should ever be necessary. Suppose we have a chassis containing two amplifiers, as diagrammed in Fig. 2, and the chassis is one station of an intercom system. The microphone amplifier transfers signals from the station's operator to the line which carries them to whatever other station happens to be connected to the system. The speaker amplifier takes signals from the line which originate at the other station and reproduces them so the local operator can hear. So far so good—and no switches necessary.

But—purely incidentally—since both the output of the microphone amplifier and the input of the speaker amplifier are connected to a common point (the line), they are also connected to each other. So the sound going into the microphone comes out of the speaker. From which point it again goes into the microphone and out the speaker. And so on *ad infinitum* to produce continuous oscillations or, in the language of the people, "a hell of a howl."

To prevent this and also save a little money, intercom manufacturers provide only a single amplifier with a multi-contact switch. With the switch pressed (it has a spring return) the loudspeaker is connected to the input as a microphone and the output goes to the line. With the switch released the speaker is connected to the amplifier output, with the input on the line. This solves the problem but makes using the intercom something of a nuisance.

The set pictured in Fig. 1 and diagrammed in Fig. 3 does it the hard way. There are separate microphone and loudspeaker amplifiers, just as in Fig. 2. Yet, there is no acoustic feedback and hence no howl because, while the microphone amplifier feeds the line and the speaker amplifier reproduces from the line—there is practically no transfer of energy from microphone amplifier to speaker amplifier through the common connection to the line! There remains the acoustic path from speaker to microphone, but oscillation requires a continuous loop; the loop is broken at the line.

This being so, we have a device which is two-way in nature—it can both receive from and transmit to a line without ill effects and without any switching. So it is also useful in telephone conversations to replace the ordinary telephone handset. In this case the line is the telephone line. The line signal can originate anywhere in the world *Bell* has a telephone. And

EDITOR'S NOTE: *This unit was intended to be used with two stations. If more than two intercom units are to be connected to the same line, they will work together or any two can be used, although all stations will be able to monitor the conversation. However, if more than three units are used, the lower-impedance taps of the cathode transformer should be used. A little experimenting will provide the answer.*

For multistation intercom use it would probably be better to insert a somewhat different switching system and it might be well to include calling buzzers since every unit that is across the line will be able to hear every conversation even if its owner doesn't participate. There should be at least one more switch position that will take the transformer off the line entirely and substitute a dummy load resistor so that each station is silent until the user puts it into operation.

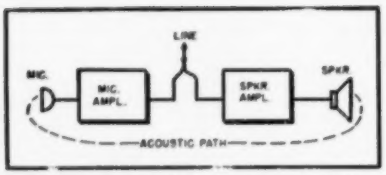


Fig. 2. One method of connecting an intercom system which will cause oscillation.

the user conducts his conversation by sitting at his desk talking at the slant-panel box (which may be a foot or two away from him) without having to hold a handset or get his shoulders out of joint. He can write, light cigars, search in desk drawers, take a drink on hearing bad (or good) news—all while conducting his conversation as though the other participant were sitting across the desk!

By the way, before adding any accessories to your telephone, check with your local phone company regarding its policies on such matters.

How It Works

Examination of Fig. 3, the complete schematic diagram, reveals no bizarre components or exotic circuits. In fact there are few parts of any kind, so that the switchless set compares favorably, economy-wise, with the usual type.

V_3 is an ordinary microphone preamplifier stage to the input of which is connected a crystal microphone. V_4 is an ordinary single-ended power output stage to the output of which is connected a 5-inch permanent magnet speaker. V_2 is really nothing but a common type of phase splitter, but since it is the heart of the idea we will go into it more thoroughly.

V_2 is the split-load or long-tailed type of phase inverter. It is a 6V6 connected as a triode rather than the more usual voltage-amplifier triode simply because, unlike most phase splitters, it must handle some power. However, it is conventional in every way.

The plate load resistor is R_7. The cathode is biased by R_8 (which is bypassed by C_7). The cathode load is not a resistor but is, instead, the high-impedance winding of a plate-to-line transformer. Operation as a phase splitter is not affected by this within the frequency range with which we are concerned. When the low-impedance winding of T_2 is properly loaded, the other winding has an impedance roughly comparable to the resistance of R_7. That being the case, the outputs taken from the plate and from the upper end of the large T_2 winding are roughly equal and are nearly 180 degrees apart. (They would be exactly 180 degrees apart except for the slightly inductive character of the cathode load.)

Now consider our mission. We must transfer a microphone signal to the line without transferring it to the grid of V_4. The microphone signal goes to the grid of V_3 and is reproduced (slightly attenuated) across both the plate and cathode loads. The cathode load is a transformer with its low-impedance winding connected to the telephone or intercom line. Therefore, the microphone signal goes out on the line.

R_9 is a 100,000-ohm potentiometer with its ends connected to the two ordinary outputs of the phase splitter through blocking condensers C_9 and C_{10}. The microphone signals reaching each end of R_9 are out-of-phase with each other with respect to ground. If they are equal, adjusting the arm of R_9 to the center of the resistance will result in zero microphone signal between that arm and ground. When this is so, no microphone signal can reach the grid of V_4 and no feedback loop can exist.

In practical fact, the two splitter outputs are not quite equal, but because they are almost 180 degrees out-of-phase, some point of cancellation can always be found on R_9, and the arm is simply adjusted to that point. Cancellation is not quite complete because of the slight phase error, but there is so much attenuation that no singing or howl occurs even with microphone and speaker much more closely coupled acoustically than Fig. 1 shows them to be.

Now we have done one part of the job. How about the other—amplifying incoming line signals and putting them into the speaker? A line signal appears as voltage across the large winding of T_2. It is not balanced out by a corresponding out-of-phase signal at the plate of V_3 as is the case with microphone signals. R_9 cannot, therefore, produce any cancellation and the line signal goes to the grid of V_4 through volume control R_{10}. It is as simple as that.

There is, of course, some little attenuation. Considering T_2 as the source, the signal passes through a voltage divider whose series arm is the lower part of R_9 and whose shunt arm is R_7 (R_7 is bypassed to ground through C_8). However, the attenuation is hardly more than 6 db and V_4 has sufficient amplification to make that unimportant. In actual use on a standard telephone line speaker volume is sufficient without being excessive and ordinary voice volume into the microphone at distances of a foot or more is quite enough to put good level into the line.

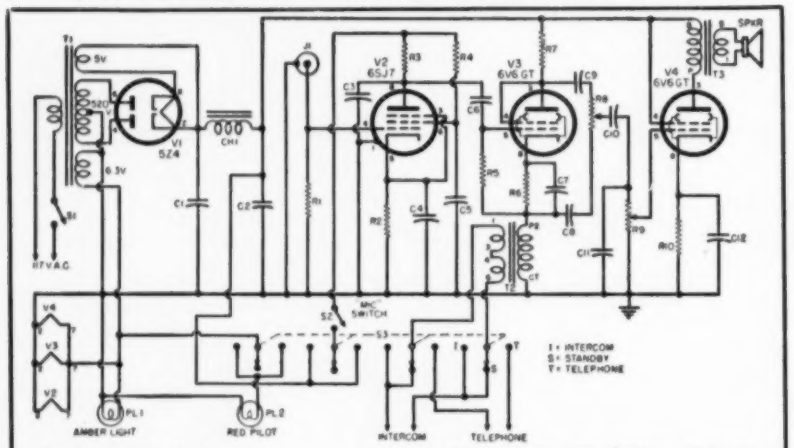
Switching

Quite a number of switching schemes can be used with this basic unit. The one chosen allows the unit to be used both as part of a two-station intercom and as a telephone amplifier. The function switch is an inexpensive 4-pole, 3-position *Mallory* unit.

In the center "Standby" position the low side of T_2 is connected to the intercom line leading to another similar station. Terminals appear on the rear, as shown in Fig. 4. Voltage is removed from the plate and screen of V_2 so that privacy is maintained when the system is not in use.

When either party wishes to call the other, S_3 is moved to the "Intercom" position. This keeps the T_2 winding on the intercom line and energizes V_3

Fig. 3. Complete schematic of the "switchless" intercom. Separate microphone and loudspeaker amplifiers are used for each station in the system.



R_1—68,000 ohm, ½ w. res.
R_2, R_6—1500 ohm, ½ w. res.
R_3—470,000 ohm, ½ w. res.
R_4, R_5—2.2 megohm, ½ w. res.
R_7—6800 ohm, ½ w. res.
R_8—100,000 ohm pot, linear taper
R_9—500,000 ohm pot, audio taper
R_{10}—330 ohm, 1 w. res.
C_1-C_2-C_{12}—40/40/40 μfd., 450/450/150 v. elec. cond.
C_3, C_9—.001 μfd., 400 v. cond.
C_4—10 μfd., 25 v. elec. cond.
C_5—.02 μfd., 400 v. cond.
C_7—50 μfd., 25 v. elec. cond.
C_8—.1 μfd., 200 v. cond.
C_6—.1 μfd., 400 v. cond.
C_{10}, C_{11}—.002 μfd., 200 v. cond.
S_1, S_3—S.p.s.t. toggle switch
S_2—4-pole, 3-pos. non-shorting rotary sw. (*Mallory* 3243-J)
T_1—Power trans. 260-0-260 v. @ 90 ma.; 6.3 v. c.t. @ 3 amps; 5 v. @ 2 amps (Stancor PC8404)
T_2—Plate-to-line trans. (Stancor A-3250)
T_3—Plate-to-v.c. trans. (Stancor A-3849)
CH_1—8 hy., 75 ma. filter choke (Stancor C-1353)
PL_1—6-8 volt pilot light assembly (amber jewel)
PL_2—6-8 volt pilot light assembly (red jewel)
Spkr.—5" PM speaker, 4-6 ohm v.c.
J_1—Single-conductor, chassis-mounting mike connector (Amphenol 75-PC1M)
V_1—5Z4 tube
V_2—6SJ7 tube
V_3, V_4—6V6GT tube

Fig. 4. Rear view of cabinet showing potentiometers R_5 and R_6, the microphone connector, J_1, and the two sets of terminals.

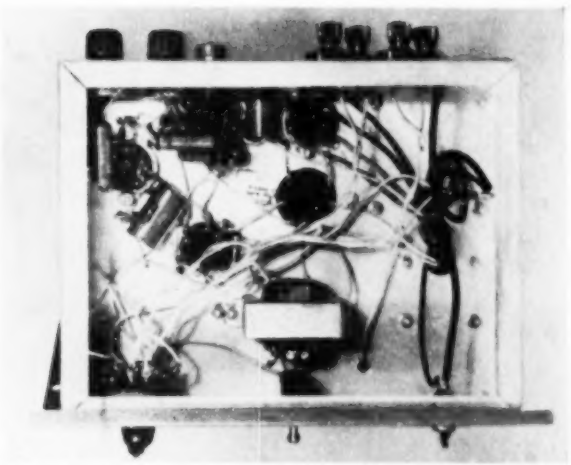


Fig. 5. Under chassis view of unit. The components used in each stage are grouped together to avoid introducing extra noise.

so that the other party can be called. To answer, the other party places his own switch in the "Intercom" position. During the conversation neither party needs to do any switching and at its end, each returns his switch to center. This places both sets across the intercom line, but removes plate voltage from the microphone amplifier; either party will now hear the other if he calls but cannot be heard himself until he decides to answer. Such "privacy" provision prevents two business partners using these sets from inadvertently broadcasting to each other their plans for selling each other out. There are, of course, some applications in businesses or institutions where one party desires to hear what is going on at the other end all the time. In that case, it is simple enough to short S_2 in Fig. 3 on one of the units and also short-circuit that section of S_3 which breaks plate voltage to the microphone amplifier.

When the phone rings, the user answers simply by switching to "Telephone."

To answer a telephone call, S_3 is moved to the "Telephone" position. This places the low winding of T_3 directly across the telephone line. The d.c. connection to the line actuates the central office relays which stop the ringing and connect the party. The conversation is carried on just as an intercom call would be, and at its end the switch is returned to center, opening the telephone line just as replacing a receiver on a hook would do in an ordinary phone call.

To make a dial call the usual instrument must be used—the handset is lifted and the call dialed. Then S_3 is placed in the "Telephone" position, the handset is replaced, and the conversation is conducted wholly with the amplifier set.

There are three special provisions connected with telephone use. First, the load resistor for the crystal microphone (a *Shure* 710A microphone was used) is very low in value, only 68,000 ohms. This is done deliberately to restrict the low-frequency response. Restricted lows reduce room boom which would otherwise be caused by having the microphone at a distance from the speaker's lips and would decrease intelligibility. Reduced bass also decreases the system's sensitivity to acoustic feedback.

The second provision is S_2, the microphone switch, which can be seen at the center in Fig. 1. It serves the same general purposes as the "hold" button on some telephone bases, allowing the user to hold the connection without having local sound audible to the party on the other end of the call. S_2 is normally left in the "on" position.

The third provision is PL_2, an additional pilot lamp with a red jewel appearing at the upper right of the picture in Fig. 1. This lights whenever S_3 is not in center position. It reminds the user that someone is "on the line"—either on the intercom or the telephone.

As can be imagined, construction is hardly a problem in view of the simplicity of this unit. The cabinet is a gray-finish sloping-panel unit measuring 8 x 10 x 8 inches, a *Par-Metal* type SF-501. The chassis is aluminum and measures 7 x 9 x 2 inches; it is fastened to the front cabinet panel with the four screws visible in Fig. 1.

Fig. 1 also shows a top-rear view of the unit with the cabinet removed and Fig. 5 shows what is under the chassis. Parts for each stage are concentrated to avoid noise. On the rear chassis apron there are two potentiometers, R_5 and R_6, of which R_6 could be replaced by a simple resistor of the same value since there is rarely need to attenuate the speaker volume. There is also the microphone connector, J_1, and two sets of terminals for the telephone and intercom lines.

The only part which might well be duplicated exactly for minimum problems is T_2, which is a *Stancor* A-3250. The power transformer, T_1, is a *Stancor* PC8404, and the function switch, S_3, a *Mallory* 3243-J.

The *Shure* microphone is especially suitable because it comes with a detachable threaded base for stand use. The base is attached with a short screw. In this case the threaded base was discarded and the screw holds the microphone through a hole in the top of the cabinet. The hole in the microphone is blind and with the screw tightened the mike is held firmly but can be rotated as desired.

Two final points should be noted. First, telephone companies do not normally sanction the attachment to their lines of equipment not supplied by them. In practice this prohibition is ignored by a large number of radio amateurs and others who use "telephone patches" and it appears that the companies are often lenient where it is obvious the attacher knows what he is doing and causes no damage. However, the user of such a device as this on the telephone line should realize that he is exceeding his rights in so doing and may be forced to disconnect it. There are, of course, no restrictions on the use of intercoms with lines privately supplied.

There seems to be little, if any, reason why amateur radio operators could not use this as a phone patch, perhaps with slight changes to suit impedances and levels. Receiver output replaces the microphone and the rig input the speaker.

Continued balance in R_5 depends on fairly constant impedances in V_2 plate and cathode circuits. The impedance of the high-impedance winding of T_2, however, varies with the load on the other winding. If the unit is used on both telephone and intercom, place a call, during it adjust R_5 on each set to the point of no howl and maximum speaker volume. Now switch both sets to the intercom line and, without changing the settings of R_5 eliminate the howl, if present, by paralleling an experimentally determined resistance across the intercom line. This may be necessary because the phone line has a relatively low impedance and the intercom line must be loaded to present the same impedance to T_2. -30-

THE POOR MAN'S "3D" CONVERTER

By JOSEPH CHERNOF

Top chassis view of the converter. It may be located remotely from associated amplifiers.

Details on a simulated stereophonic system designed to be used with two standard amplifiers and two speakers

PRACTICALLY no audio enthusiast or experimenter who has witnessed a well planned demonstration of binaural or stereophonic sound has failed to be deeply impressed by the results. However, when the demonstration is over and said enthusiast or experimenter is permitted to examine the working parts, he invariably forms an even deeper impression of relative complexity and expense. Unfortunately, he is generally correct.

Both the binaural and stereophonic effects require a minimum of two separate channels at both the recording and reproducing ends to achieve their goal of completely lifelike reproduction of recorded music. While the average listener does not directly concern himself with complexities at the recording end, these same complexities have so far limited the total recorded output of this type to a handful of special records and tapes. On the reproducing end, of course, dual pickups are required and these, in turn, feed dual preamps, amplifiers, and speakers. Little wonder that the net result of balancing relative expense against limited utility has been to keep most audiophiles from enjoying the pleasures of "3D" sound and, instead, contenting themselves with the improvement of single-channel systems to the highest level possible.

This is unfortunate, especially when we consider that it is a generally accepted fact that a stereophonic system of limited frequency range is superior by every listening test to a single-channel system of several octaves more range than the stereophonic system.

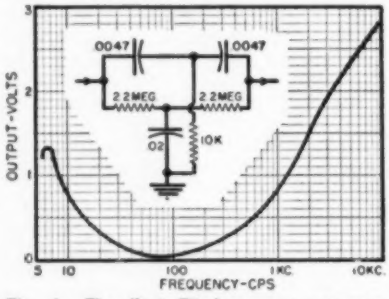


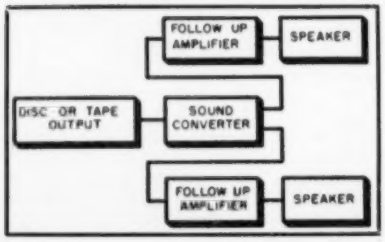
Fig. 1. The "twin-T" frequency response for 3 volts input. Output voltage is plotted versus the frequency in cycles-per-second.

In this connection, the writer has endeavored to determine if the stereophonic illusion of depth and liveness could be duplicated through the use of basic available single-channel systems. The end result described here is a "3D" sound converter for use with conventional sound systems for converting a single sound source into two sound sources, sufficiently different in phase structure and frequency spectrum from each other to create the stereophonic effect. This synthetic binaural sound is then fed into two separate conventional amplifiers, each with its own speaker system. It should be pointed out here that the separation of a single sound input into two separate channels within an amplifier and their recombination within the same amplifier in the output stages is nothing new to the field. By and large, the results have not been outstanding. In the system here described, the "3D" sound converter is followed up with separate amplifiers and speakers, and the synthetic binaural sounds retain their identity throughout the system, thus avoiding such undesirable effects of recombination within an amplifier as complex intermodulation products and spectrum cancellation and addition effects. As in a true stereophonic system, recombination takes place only at the ears of the listener.

Should the reader feel by now that this system comes perilously close in complication to a true stereophonic or binaural system, let me point out some essential differences. First, instead of being confined to the very limited number of available disc and tape recordings of the sterophonic variety, the listener may achieve the simulated stereophonic effects while playing any conventional record or tape in his collection. Secondly, strictly conventional playback systems are used as opposed to the dual-head pickups required for true stereophonic reproduction. While the "3D" converter does necessitate the use of dual amplifier and speaker systems, any two very ordinary audio amplifiers coupled with speakers of modest quality, sensibly mounted and located, will give results better in every respect than a single-source sound system of the highest quality throughout.

An acquaintance of the writer who is using a "3D" converter has come up with the following makeshift, but

Fig. 2. Block diagram of the "3D" converter.



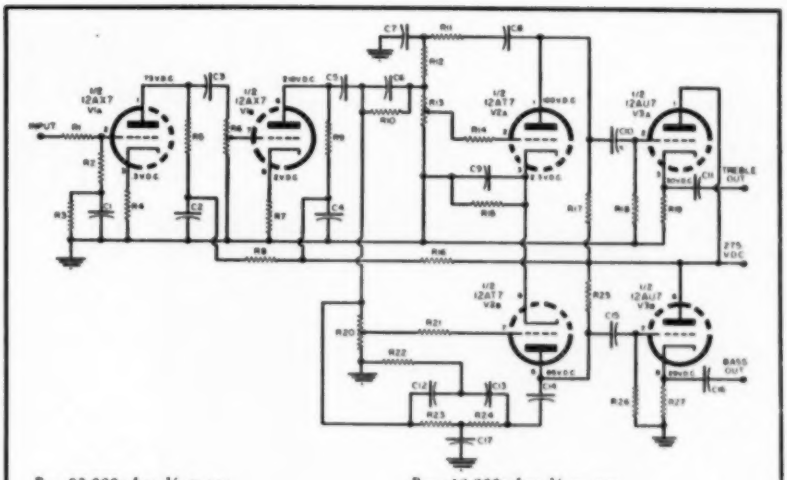
completely satisfactory, solution to this problem. He uses his existing amplifier and speaker system for the bass-predominant output of the sound converter and couples the treble-predominant output of the sound converter to the phono input jack of his console TV set. After a little experimentation with speaker location, the results were very gratifying.

Fig. 3 shows the schematic diagram of the complete "3D" sound converter. The first two stages, employing triodes V_{1A} and V_{1B}, are of the usual preamplifier variety. Ample gain is provided for variable reluctance or other type of magnetic pickup. No attempt has been made to provide a means of adjusting equalization to accommodate each of the wide assortment of record types, for the sake of simplicity. C_1, whose value is not specified in the parts list, would be the logical place to insert the desired corrective network. For the value of C_1, if it proves desirable, it is suggested that the builder try various values until best results are obtained. The value of this condenser is relatively small. A 250 $\mu\mu$fd. unit is a good starting point. However, tone controls on the two follow-up amplifiers should easily provide enough flexibility of adjustment in the completed system to accommodate any type of record.

Note that no internal power supply is shown in the belief that one or the other of the follow-up amplifiers would be capable of supplying the approximately 6 milliamperes "B-plus" drain of the converter. A master gain control, R_6, is shown in the grid of V_{1B}. The preamplifier output is fed to two separate parallel amplifier channels which are so constructed that one channel responds predominately to the lower register of audio frequencies, and the other channel responds predominately to the upper register of audio frequencies. The channels are referred to here as bass-predominant and treble-predominant.

The output of V_{1B} is coupled to the grids of triodes V_{2A} and V_{2B}. Individual level controls, R_{13} and R_{20}, are provided for each channel. The phase and frequency structure of the original signal is altered by means of selective feedback in each of the two channel amplifiers to provide the desired stereophonic effect. In the treble-predominant stage, V_{2A}, the input signal passes through a high-pass filter consisting of C_6 and R_{10} and is amplified through the tube. Low frequency components present at the plate of V_{2A} are then fed back out-of-phase to the grid of V_{2A} through a low-pass filter R_{11}, C_8, and R_{12}. The end result is that the signal at the plate of V_{2A} has been considerably altered in phase and frequency structure from the original.

In the bass-predominant amplifier, V_{2B}, the input signal is connected directly to the grid and amplified through the tube. Plate-to-grid feedback is again used, but here it is of a more complex nature than that used in the treble-predominant amplifier.



R_1—82,000 ohm, ½ w. res.
R_2—5600 ohm, ½ w. res.
R_3—56,000 ohm, ½ w. res.
R_4—1000 ohm, ½ w. res.
R_5, R_{10}, R_{15}—100,000 ohm, ½ w. res.
R_6, R_{13}, R_{20}—500,000 ohm pot
R_7—4700 ohm, ½ w. res.
R_8, R_{16}—10,000 ohm, 2 w. res.
R_9, R_{14}, R_{21}—47,000 ohm, ½ w. res.
R_{11}, R_{17}, R_{22}—220,000 ohm, ½ w. res.
R_{12}—2000 ohm, ½ w. res.
R_{18}, R_{26}—470,000 ohm, ½ w. res.
R_{19}, R_{27}—47,000 ohm, 1 w. res.
R_{23}—10,000 ohm, ½ w. res.
R_{25}, R_{24}—2.2 megohm, ½ w. res.
C_1—See text
C_3, C_4—10 μfd., 300 v. elec. cond.
C_5, C_6, C_9, C_{10}, C_{11}, C_{14}, C_{15}, C_{16}—.05 μfd., 400 v. cond.
C_8—250 $\mu\mu$fd. mica cond.
C_7—500 $\mu\mu$fd. mica cond.
C_{12}—50 μfd., 25 v. elec. cond.
C_{13}, C_{18}—.0047 μfd. mica cond.
C_{17}—.02 μfd. mica cond.
V_1—12AX7 tube
V_2—12AT7 tube
V_3—12AU7 tube

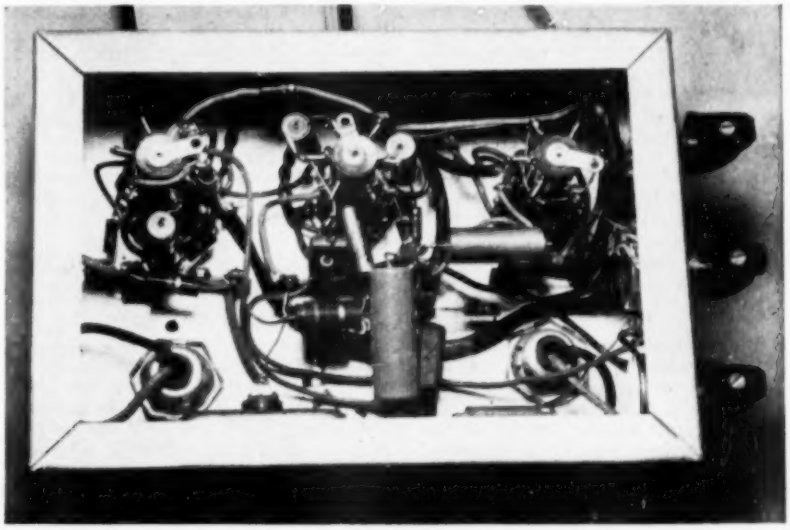
Fig. 3. Schematic of the "3D" converter. With all gain controls set at maximum and an input of .01 volt at 400 cps, the output of the bass-predominant channel is .9 volt. With the input .01 volt at 10,000 cps, output of treble channel is .78 volt.

A "twin-T" filter network is connected, for feedback purposes, between the plate and grid of V_{2B}. Its response characteristics are shown in Fig. 1. Note that the feedback is negative and practically unity at the higher audio frequencies, decreasing to a minimum at about 70 cycles. Feedback then increases for frequencies below 60 cycles, however, due to the transmission characteristics of the "twin-T," phase shift through the filter approaches 180°, resulting in quasi-positive feedback.

This feedback system produces some interesting results at the very lowest frequencies in the audio spectrum. Low-frequency transient pulses present in the original sound tend to be reduced in harmonic content to more nearly pure fundamental tones. This is a desirable effect, since these complex low-frequency waveforms generally run into trouble in any but the most elaborate speaker systems, trouble of the type where the harmonics tend to mask the fundamental tones

(*Continued on page* 116)

Under chassis view. Note that Vector sockets have been used to conserve space.

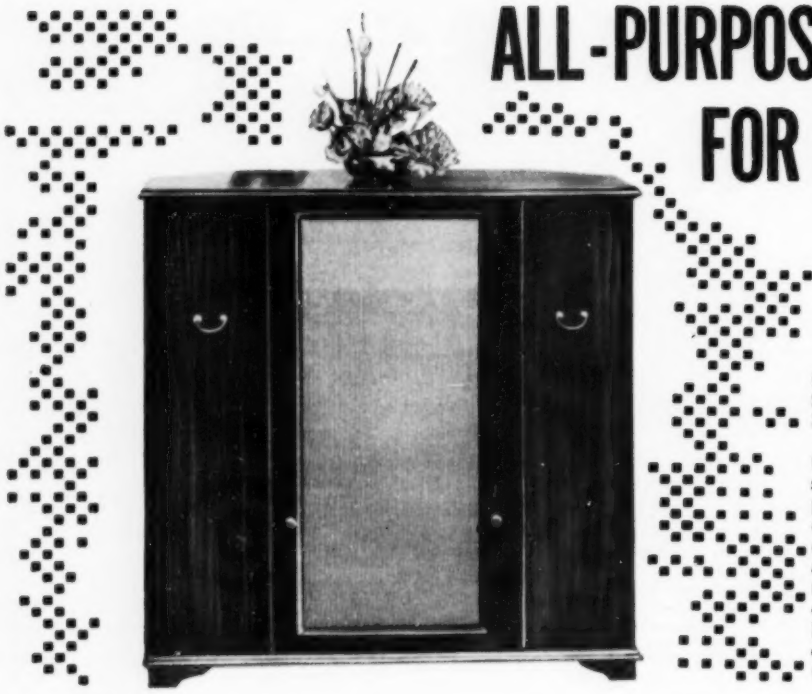


ALL-PURPOSE ENCLOSURE FOR 12" SYSTEMS

By **OLIVER READ**

Editor and Asst. Publisher

RADIO & TELEVISION NEWS



Part 1. An improved and more compact design of the "Fold-a-flex" loudspeaker enclosure. It provides a choice of folded horn, bass reflex, infinite baffle.

THE "all-purpose" loudspeaker enclosure described in these pages just one year ago has met with considerable success. Many of our readers built the "Fold-a-flex" from the data supplied for 15" systems[1]. Much time has been spent since by the author in a series of experiments with several enclosures (employing the "Fold-a-flex" principle) of smaller dimensions. Working models have been constructed, tested, and measured for response and impedance characteristics for loudspeakers with 5" to 15" cones and several two-, three-, and four-way systems.

As was expected, the larger enclosures outperformed the pint-sized designs in every respect.

Smooth response in the important bass region requires loudspeakers having cones of from 12 to 18 inches in diameter. These require cabinets of sufficient size to provide the all-important characteristics for loading and damping of the cone. In addition, they must be ruggedly built, properly braced, and constructed of wood at least ¾" thick.

Our approach was to determine the *minimum* dimensions for the "Fold-a-flex" enclosure that would provide the basic characteristics of folded horn, infinite baffle, or bass reflex for the audio range from 40 cycles. Several of the 12" hi-fi loudspeakers were measured and found highly compatible to the design.

There are three *basic* types of enclosures. Each has its own characteristics and each will sound different (even with identical loudspeakers). The finest loudspeaker will, in the wrong enclosure, sound worse than many inferior loudspeakers in the proper enclosure. Leading manufacturers of high-fidelity speakers have recognized the importance of designing the enclosure to meet the requirements of a particular loudspeaker. They have been literally forced into the cabinet business—just to make sure that the reproducing system would be capable of providing distortion-free high-fidelity sound at wide dynamic range from their own loudspeakers. Unfortunately, people's tastes differ widely in selecting cabinets and loudspeakers. Many are satisfied with a good 12- or 15-inch coaxial loudspeaker. Others prefer a two-way woofer-tweeter combination. A great many now enjoy the benefits of the fine three-way systems comprising woofer, mid-range horns, and high-frequency tweeters.

Choosing the right enclosure for a loudspeaker is no easy task, and too often the choice of enclosure is made on cabinet shape, size, or appearance alone without carefully considering the all-important acoustical properties of the cabinet and its effect on the performance of a hi-fi loudspeaker system. Too often results are poor simply because a good loudspeaker is installed in the wrong type of enclosure. What do we mean by *types* of enclosures for loudspeakers?

There are three basic types of "baffling" or enclosures. They are: 1. the folded horn, 2. the infinite baffle, and 3. the bass reflex.

The "folded horn" provides an effective loading to the cone of the loudspeaker diaphragm and is capable of providing better bass at higher efficiency than other types. It gives a close coupling to the air, reduces distortion, and eliminates or minimizes the resonant effects of the loudspeaker. Because of the horn-loading effect, the loudspeaker cone moves but a fraction of the distance (in piston-like fashion) than would otherwise occur.

The "infinite baffle" is considered by many authorities to be the best method for mounting loudspeakers. A cabinet providing such characteristics is generally a completely enclosed box (enclosure) carefully braced to prevent vibrations and padded to absorb sounds bouncing around within the enclosure. This type of enclosure (baffle) requires a minimum inside area (air volume) of at least 10 cubic feet for 15" loudspeakers, and at least 6 cubic feet for 12" cones. It is capable of good performance with many single or coaxial speakers.

The "bass reflex" type of enclosure has been popular for many years and is considered to be the least expensive type of those capable of providing satisfactory bass performance. The enclosure employs a port (opening) which is placed below the loudspeaker cone. The area of this port must be exactly related to the inside volume of the enclosure and the resonance of the loudspeaker cone. Unfortunately, commercial reflex cabinets are made with the reflex port dimensions designed for one specific loudspeaker.

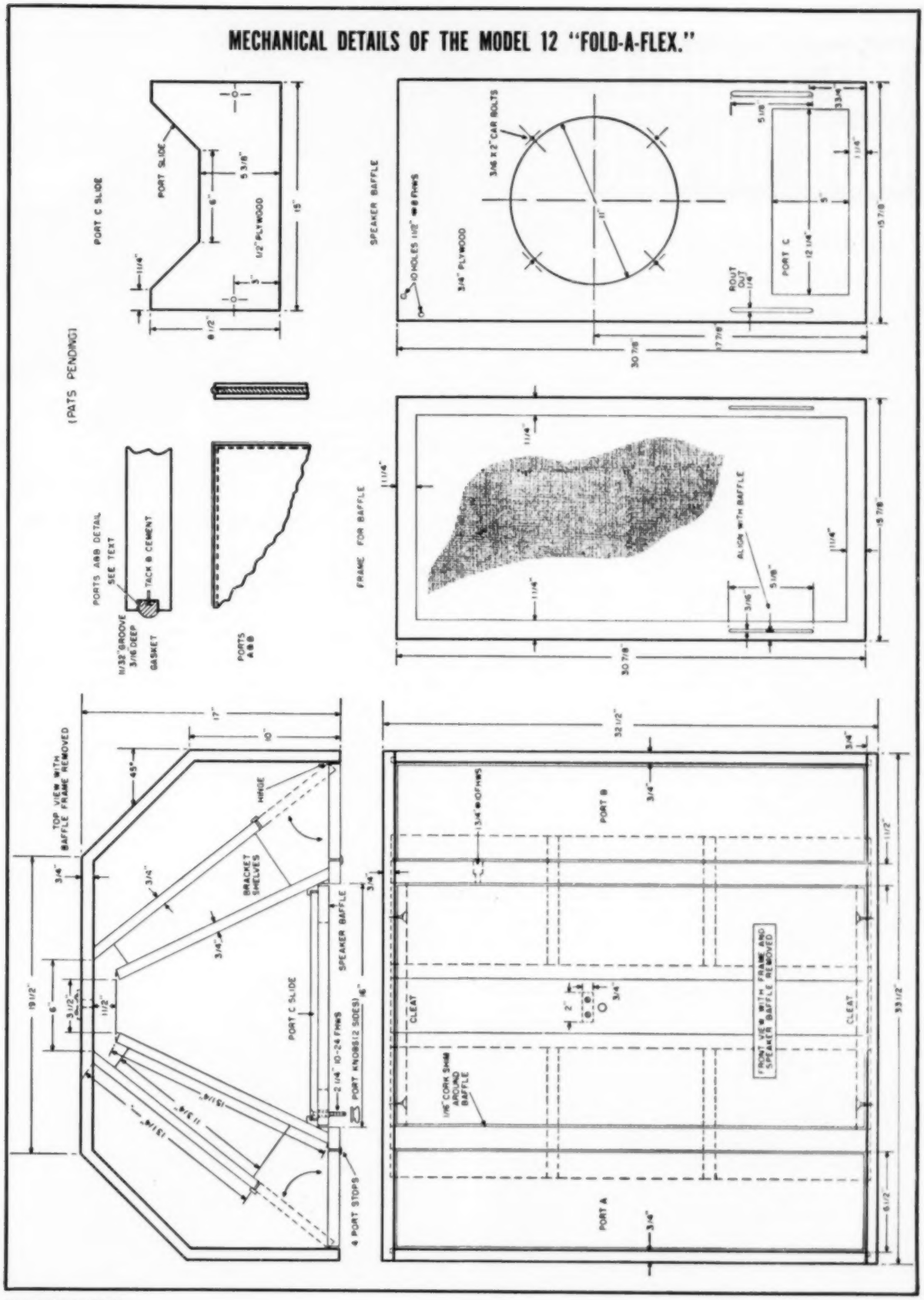
Which One Is Best?

That depends on many things—the size of the room in which it is to be placed, the acoustical behavior of the room, the particular loudspeaker or multiple speakers chosen, the location in the room, and the personal tastes of the audiophile. Any one of the three types of enclosures can, if well constructed and *properly designed for a specific loudspeaker*, give good performance. Is it possible to have all three types of baffling in one cabinet so that each may be compared per-

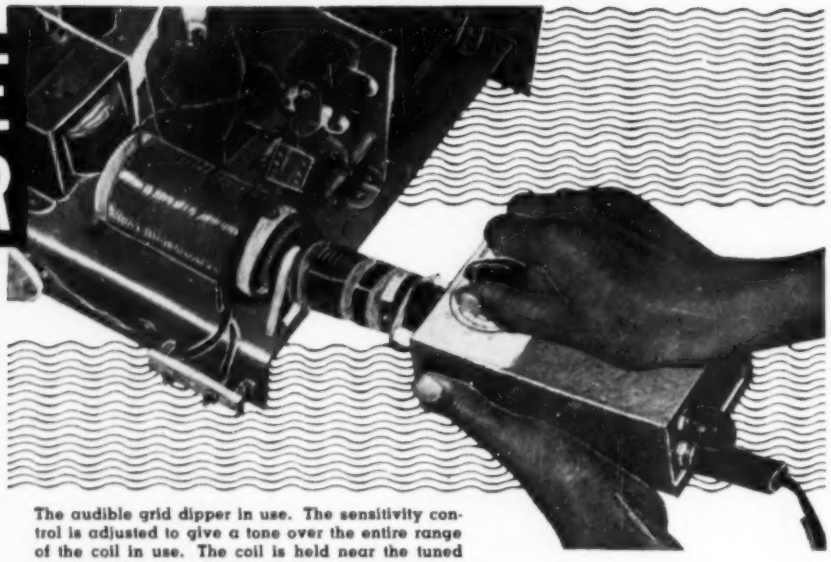
(*Continued on page* 168)

[1] RADIO & TELEVISION NEWS, Oct., Nov. 1953

MECHANICAL DETAILS OF THE MODEL 12 "FOLD-A-FLEX."



THE AUDIBLE GRID DIPPER



The audible grid dipper in use. The sensitivity control is adjusted to give a tone over the entire range of the coil in use. The coil is held near the tuned circuit under test. Tone will cease at resonance.

By **R. W. JONES, W6EDG**

Got those "budget blues"? Here is an inexpensive unit that covers from 2.7 to 37 mc. by means of five plug-in coils.

ANY grid dip meter is a calibrated variable frequency oscillator with some method of indicating when power is being taken from the grid circuit. The most common indicating device is a microammeter or low-range milliammeter; these meters have two outstanding characteristics: they are sensitive and they are expensive. I wanted to be able to check tuned circuits for resonant frequencies, to read the natural resonant frequency of an antenna, to do most of the pruning on coils when building them and not later when it is more difficult mechanically, and I wanted to be like the rich hams but I didn't have the dollars to expend for a grid dipper. They are worth their money and I'm going to buy a good grid dip meter kit—probably a *Heathkit*—with my next extra cash. Until I have that extra cash—according to my figures and my wife's budget it will be sometime in 1960—I have a very good substitute for a grid dip meter.

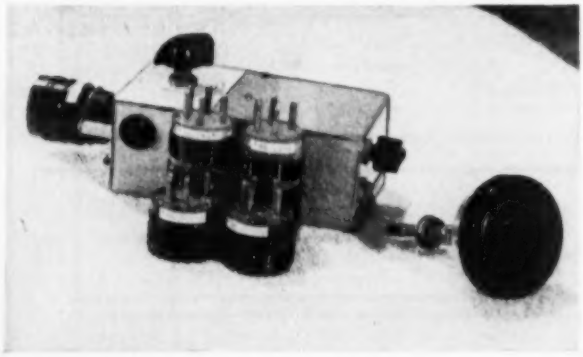
My home-built substitute does everything that most grid dip meters will do and it costs much less. The unit described cost me less than $2.50 in actual expended cash. I used as many parts as I had available in my miscellaneous spares—that's fancy for "junk box." If you are content to operate the instrument from your receiver power supply and not enjoy the luxury of portability you can dispense with the batteries and reduce the cost even more. I like to work on antennas and therefore wanted this unit portable enough to be carried out to my car to check the center loaded vertical or carry it up on the roof of the house.

This audible grid dipper gives an indication in a pair of phones, or in the one earphone plugged in the instrument, when the resonant frequency of the tuned circuit under test is the same as the frequency of the grid dip oscillator. When the oscillator is operating and no r.f. power is being absorbed by an external circuit there is a steady tone in the phones. When the plug-in coil of the grid dipper is held near a tuned circuit that, because it is resonant at the same frequency, will take r.f. power from the oscillator the tone will stop in the phones. On commercial grid dip meters the meter will dip—hence the name, I guess—but on this "economy model" the tone will stop. I have checked mine against factory built and calibrated instruments costing over 60 dollars and we both got the same reading. I will concede that mine takes more skill, but—after all—that's what we hams claim to be: skilled radiomen. This is a cheap method for those of us who run low power to get the most from an antenna. An antenna that is naturally resonant at the operating frequency will radiate much more than one that is loaded—speaking either of mobile or fixed antennas—and will give more and better QSO's for each dollar expended.

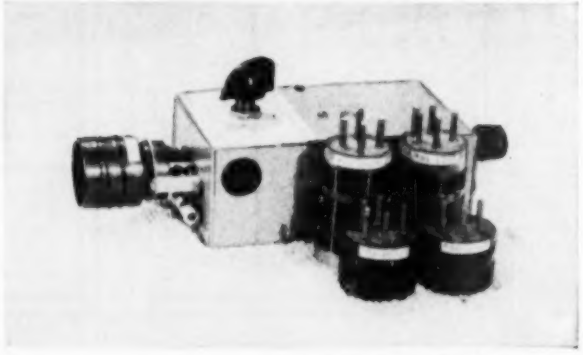
The MO (as they say on "Dragnet") is an old one and the old timers who used detectors and two-step audios will recognize this tone when it is heard. It isn't as much a tone as it is a squeal and it covers the entire dial. When the dial is tuned through resonance the tone will stop. Read the dial and it's the resonant frequency of the tuned circuit.

This oscillator has an abnormally large grid condenser and a high value of grid leak. They are C_2 and R_2 on the diagram. The grid condenser, C_2, is nominally used to provide a path for

The audible grid dipper with its five coils and the single earphone. The tone from the earphone is audible in a quiet room. The push-button is visible at left of the plug-in coil forms.



Another view of the audible grid dipper and its plug-in coils to cover the frequency range from 2.7 to 37 mc. The plate bypass condenser is mounted on the coil socket as shown in photo.



BAND	L_1	L_2
2.7-6 mc.	34 t. #22 en. closewound	15 t. #22 en. closewound
6-11 mc.	14 t. #22 en. 1" winding length	13 t. #22 en. closewound
10-18 mc.	6 t. #22 en. ½" winding length	5 t. #24 en. closewound
17-24 mc.	3½ t. #22 en. ½" winding length	5 t. #24 en. closewound
21-37 mc.	2½ t. #22 en. ¼" winding length	3 t. #24 en. closewound

Table 1. Details for winding the five coils to cover frequencies from 2.7 to 37 mc.

the r.f. circuit current but act as an open circuit for the d.c. bias voltage. If the resistance of the grid leak, R_2, is high enough and the capacity of the grid condenser, C_2, high enough the oscillator will develop enough grid bias voltage to charge up the condenser and bias itself off. C_2 and R_2 are in a small RC circuit with a time constant equal to $1/RC$. The oscillations of the r.f. oscillator cease—because of the tube biasing itself off—and will not start again until some of the negative charge on C_2 has leaked off through the grid leak. When the charge has leaked off enough to permit the tube to start oscillating again C_2 is immediately recharged and the tube biases itself off again. The process continues: off and on. The oscillations are going off and on at an audio rate and the plate current of the tube is varying at an audio rate. There is, therefore, an audio tone in the phones that is at the same frequency as the interruptions of the oscillations.

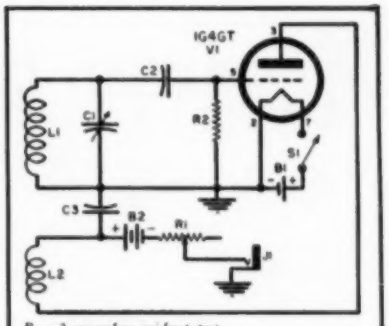
The oscillator is operating at a very unstable point and if any power is taken from the grid circuit it will not be capable of producing enough power to develop its own grid bias. If we couple this small interrupting oscillator to a tuned circuit that will take some power from it, the r.f. oscillations will stop. If the oscillations stop the tone stops because it will quit operating as an interrupted oscillator. If we detune the oscillator and the external tuned circuit, no longer resonant with the grid dipper, quits taking power and the r.f. oscillations will start. It will start biasing itself off and coming on again at the audio rate and the tone will again be audible in the phones.

About twenty years ago I used to build small regenerative receivers and sometimes would have this squeal in the phones. I never did know what caused it but I did know that changing the grid leak or grid condenser would cure it. Now I know why.

My grid dipper is built in a small interlocking type case 5¼" x 3" x2⅛". They are made by several manufacturers of chassis and cabinets. Everything is inside the case. It is battery operated using a penlite cell for the filament and a small hearing-aid type 30-volt battery for the plate supply. The battery drain is very low. The plate current is 50 microamperes and the filament drain is 50 milliamperes. The batteries should have a long life. The penlite cell is held in position by a bracket soldered to its case which gives mechanical support and also provides a ground return. The bracket is bolted to the tube socket support. The 30-volt cell is held in place by a wire strap and also by the heavy wire lead from the negative post to the midget 2-megohm potentiometer.

The operating switch is in the filament lead. It is a push-button type doorbell switch. It is located so the thumb of the left hand will just comfortably reach it and leave the right hand free for turning the dial. Using a push-button type switch precludes any chance of leaving it turned on and exhausting the batteries. I have a single earphone mounted on a phone plug by a wire heavy enough to make it self supporting. This is handy when I do not want to use earphones. The tone is loud enough to be heard in a quiet room.

Coils to cover the frequency range from 2.7 mc. to 37 mc. are wound on



R_1—2 megohm midget pot
R_2—3 megohm, ½ w. res.
C_1—100 μμfd. var. cond. (Bud MC1855 or equiv.)
C_2—250 μμfd. mica cond.
C_3—1000 μμfd. Ceramicon cond.
J_1—Phone jack
S_1—S.p.s.t. push-button switch (doorbell type)
B_1—1½ volt penlite cell
B_2—30-volt miniature battery (Eveready 431)
L_1, L_2—See coil table
V_1—1G4GT tube

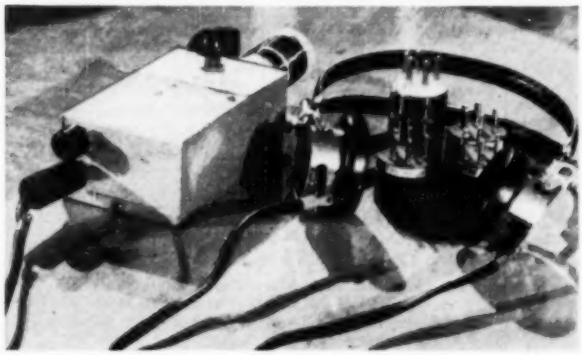
Complete schematic diagram of the compact grid dipper. Battery drain is very low.

five forms. Two of these forms are manufactured forms and the three, for the higher frequency bands, are old tube bases. I used an *ARRL* "Lightning Calculator" for figuring the number of turns and it saved a lot of cutting and trying. The top of the largest winding, L_1, goes to the grid condenser, C_2. The bottom of L_1 goes to ground. The top of the feedback winding—wound in the same direction as the grid winding—goes to the positive post of the battery. The bottom of L_2 connects to the plate of the 1G4GT. The plate bypass (C_3) is mounted right at the coil socket. Scrape the paint when grounds are made to chassis. The amount of feedback produced by the feedback winding is critical if it is to produce a good tone over the entire range of each coil. If the tone stops on the low-frequency end the feedback winding (L_2) needs more inductance; if the tone stops on the high-frequency end cut some turns from the feedback winding.

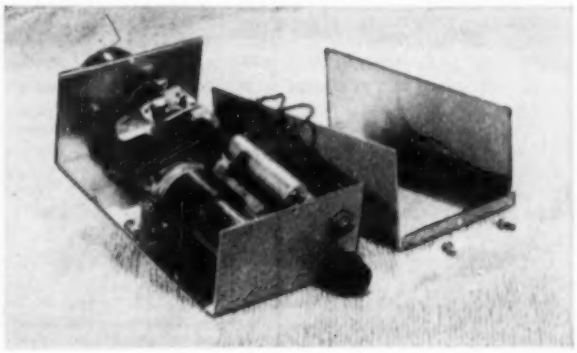
Calibrating the dipper is easy. Use your general coverage receiver. You can't miss the signal from this audible grid dipper. It is the wildest, most ter-

(*Continued on page* 128)

Audio grid dipper ready for use. A pair of headphones takes the place of the expensive microammeter used in conventional grid dip meters. The knob above plug is sensitivity control.



All components, except the push-button switch, are mounted in one-half of the interlocking-type chassis. Tube is mounted so its socket is near the tuning condenser to permit short leads.



1954 TV RECEIVER SPECIFICATIONS

Continuation of the list of mechanical and electrical specifications on current model TV sets for service technicians. See next issue for additional listings.

MFR.	CHASSIS	TUBES							VIDEO I.F. FREQ (MC.)	H.V.[4] (KV.)	U.H.F. PRO-VISION	POWER (WATTS)	SPECIAL FEA-TURES
		TUNER	I.F.[1]	VIDEO[2]	AUDIO	SWEEP[3]	P.S.	CRT					
STROMBERG-CARLSON (Cont'd.)	624	6BQ7 or 6BZ7 6J6	6CB6 6CB6 6CB6	6U8* 6W6	6AU6 6T8 6U8* 6V6GT	6AL5, 6AU6 6AX4GT,6AX4GT 6BL7GT, 6C4 6CD6G 6SN7GT, 6U8* 12AU7	1B3GT 5U4G 5U4G	24CP4A	45.75	17.5	Strips	265	5, 8 Noise Control
	625	6AF4 6BZ7 6X8	6CB6 6CB6 6CB6	6U8* 6W6	6AU6 6T8 6U8* 6V8	6AL5, 6AU6 6AX4GT,6AX4GT 6BL7GT, 6C4 6CD6G, 6SN7GT 6U8*, 12AU7	1B3GT 5U4G 5U4G	24CP4A	45.75	17.5	11	265	5, 8, Noise Control
	624 RPM	6AL7 6AU6 6BA6 6BE6 6BQ7 or 6BZ7 6CB6 6J6 12AT7	6AU6 6BA6 6BA6 6CB6 6CB6 6CB6	6AL5 6U8* 6W6	6AU3 6F3 6F3 6T8 6U8* 12AT7 12AX7	6AL5, 6AU6 6AX4GT,6AX4GT 6BL7GT, 6C4 6CD6G, 6SN7GT 6U8*, 12AU7	1B3GT 5U4G 5U4G 5U4G	24CP4A	45.75	17.5	Strips	400	5, 7, 8, 9, Noise Control
	625 RPM	6AF4 6AL7 6AU6 6BA6 6BE6 6CB6 6BZ7 6X8 12AT7	6AU6 6BA6 6BA6 6CB6 6CB6 6CB6	6AL5 6U8* 6W6	6AU3 6F3 6F3 6T8 6U8* 12AT7 12AX7	6AL5, 6AU6 6AX4GT,6AX4GT 6BL7GT, 6C4 6CD6G, 6SN7GT 6U8*, 12AU7	1B3GT 5U4G 5U4G 5U4G	24CP4A	45.75	17.5	11	400	5, 7, 8, 9, Noise Control
TRAV-LER	46A3	6BQ7 6J6	6AU6 6AU6 6AU6	6AH6 6AL3	6AL5 6AU6 6AV6 6V6	6BQ6, 6C4 6C4, 6S4 6SN7, 6SN7 6W4	1B3 5U4	17HP4 21YP4	26.25	14	Strips	185	10
	46B3							17HP4	26.25	14	Strips	185	10
	46C3	6BQ7 6J6	6AU6 6AU6 6AU6	6AH6 6AL3	6AL5 6AU6 6AV6 6V6	6BL7, 6C4 6C4, 6CD6 6SN7, 6SN7 6W4	1B3 5U4	24CP4A 24TP4	26.25	16	Strips	185	10
	47A3	6AF4 6BZ7 6J6 6T4	6CB6 6CB6 6CB6	1N64 6AH6	6AL5 6AU6 6AV6 6V6	6BQ6, 6C4 6C4, 6S4 6SN7, 6SN7 6W4	1B3 5U4	17HP4 21YP4	45.75	14	11	185	10

1. Video i.f. tubes only. 2. Includes detector and a.g.c. 3. Includes sync section and a.f.c. 4. CRT 2nd anode voltage. 5. Removable safety glass. 6. Local-fringe a.g.c. adjustment. 7. High-fidelity sound. 8. Aluminized picture tube. 9. TV-radio-phono combination. 10. Built-in antenna. 11. 82-channel tuner. 12. Adjustable dial light. *Part of tube is used in another section.

A FOUR-CHANNEL AUDIO MIXER

The four-channel audio mixer. All of the controls are identified. The "not-used" toggle switch was incorporated to provide an extra switch should it be required. It could serve as a power supply "on-off" control, if desired.

By **JOHN S. CARROLL**

Construction details on a professional-type unit which uses only four audio transformers instead of the usual eleven.

EVERY recording studio except the very smallest has, on occasion, need for audio mixing facilities. Unfortunately, most of the inexpensive mixing equipment that is commercially available is, at best, of amateur quality while professional-type equipment is usually priced in direct proportion to its quality.

The problem faced by the author in building the unit to be described was one of small budget and the fact that the mixer was to be used with professional-type recording equipment. The mixer could not be permitted to add materially to either the noise level or distortion of the system. Thus, such shortcuts as had to be made to keep the cost to a minimum, had to be taken keeping this performance requirement firmly in mind.

The particular studio for which this unit was intended was that of a producer of documentary motion pictures and the facilities were designed for recording sound tracks by the "live-mix" method. That is, the narrator's (or at times, two narrators') voice would be recorded on, at most, two microphones while simultaneously the musical score would be dubbed from discs or tape. A total of four channels were therefore required, two for microphones and two for phonographs.

Under normal circumstances a professional - type, four - channel mixer would have a total of nine transformers up to the mixer stage, four input transformers to the preamplifiers, four output transformers from the preamplifiers to the line-mixer potentiometers, and a line-to-grid transformer to the mixer stage. Two additional transformers would be required, between the mixer stage and the output of the "line" amplifier and an output transformer to line, making a total of eleven audio transformers required in the whole unit.

In the mixer unit to be described the total number of audio transformers was reduced to four by resorting to the following expedients. It was decided at the beginning that the phonograph channels would be fed by a pair of the new, high-fidelity crystal pickups, eliminating the need for preamplification for the two phono stages. Thus, only two input transformers were required.

With the preamplifiers and mixing amplifier on a single chassis, there appeared to be little objection to high-independence mixing, especially since the associated power supply would be remotely placed. Using molded carbon-element potentiometers (*Ohmite* or *Allen-Bradley* types) cut down on the slider noise and "frying" until it was virtually inaudible as compared to ordinary broadcast radio-type volume controls. In any case, the mixing is done at a point in the circuit where the signal levels are high and not too much amplification follows the mixer potentiometers.

Many references in current audio literature point out that a mixer circuit of this type tends to have some interaction between the channel controls. Our experience with this unit indicates that this particular problem has perhaps been unduly exaggerated. If any interaction exists, it is so slight as to be completely negligible. Some variation in the noise level was found at a point about two-thirds of clockwise rotation of the master gain control. This was eliminated by a slight circuit change which will be explained in detail later in this article. Interaction between the channels is apparently completely eliminated by the isolation resistors connected in series with each of the potentiometers.

The basic circuit is the one recommended by *United Transformer Company* for a portable remote broadcast amplifier. The two phonograph channels were added by simply paralleling them with the original two mixer potentiometers. Construction is straightforward but due to the very high gain of the unit certain precautions must be taken. For the lowest possible hum level, the ground points are placed as near the two inputs as possible. These, then, are the only two places where the ground connects to the chassis. A ground bus is used between these two points and the "B−" terminal and is completely insulated from the chassis at all other points. All of the other grounds, including the condenser cans, are insulated from the chassis and connected to the ground bus.

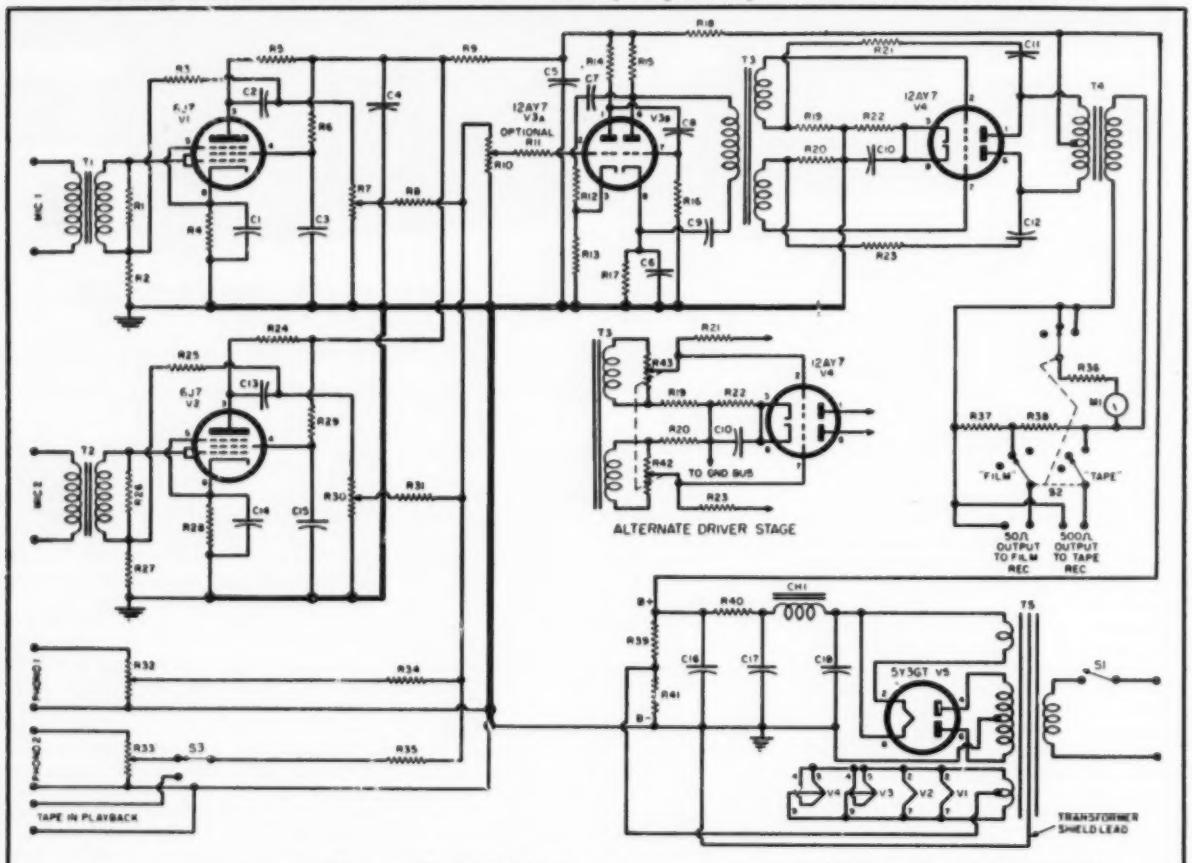
The heater circuit is not grounded at any point. The center tap of the 6.3 volt winding is returned to a tap on the voltage divider across the power supply. This places a fairly high positive bias on all heaters and prevents hum due to heater-cathode leakage or heater emission. With these precautions it proved unnecessary to use d.c. on the heaters of the preamplifier tubes. If any residual hum is present

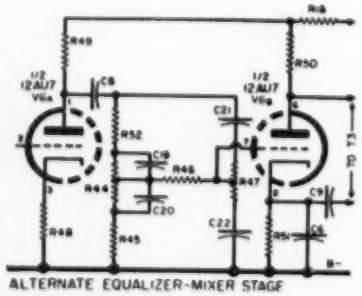
despite this precaution, it can be minimized by increasing the value of the cathode bypass condensers, C_1 and C_{14}, to 100 μfd. or higher.

In order to insure minimum distortion, feedback is used around the preamplifiers, around the mixer amplifier stage, and around the output stage. There is little or no danger of instability due to the loops around the preamplifiers and, in this case, the output stage also exhibits good stability. However, some resonance between the interstage transformer windings and capacitances in the mixer stage caused an ultrasonic oscillation which, while not audible, threw the vu meter completely off scale. This oscillation was suppressed by placing small phase-shifting condensers (50 to 100 μμfd.) across either R_{18} or R_{19}, or both.

If the builder wishes to add an equalizer to the unit, this may be placed between the two mixer amplifier stages and the feedback loop eliminated to provide sufficient gain for the equalizer. A 12AU7 was used in

Complete wiring diagram for the four-channel audio mixer. If only two inputs, Mic. 1 and Mic 2, are required, the schematic with its original driver stage will work without any difficulty. Should Phono 1 and Phono 2 inputs be required in addition, interaction may occur between the various controls. To eliminate this, it is suggested that the alternate driver stage shown below be used in place of the original circuit. When this is done, the master gain control R_{10}, is replaced by a standard 3-megohm, ½-watt resistor. The dual potentiometer, R_{42}-R_{43}, then becomes the new master gain control. Resistor R_{11} should be connected to the top of the newly-connected 3-megohm resistor to obtain maximum gain. Also shown below is an alternate equalizer-mixer stage. This has not been incorporated in the audio mixer unit. It should, however, work out advantageously and may be worth the installation effort involved.





R_1, R_{28}—68,000 ohm, ½ w. res.
R_2, R_{27}, R_{47}—10,000 ohm, ½ w. res.
R_3, R_6, R_{25}, R_{29}—1.5 megohm, ½ w. res.
R_4, R_{26}—1800 ohm, ½ w. res.
R_5, R_{24}—270,000 ohm, ½ w. res.
R_7, R_{23}, R_{32}, R_{33}—500,000 ohm audio taper pot
R_8, R_{21}, R_{34}, R_{35}—470,000 ohm, ½ w. res.
R_9—20,000 ohm, ½ w. res.
R_{10}—3 megohm pot
R_{11}—100,000 ohm, ½ w. res. (if required)
R_{12}—120,000 ohm, ½ w. res.
R_{13}, R_{17}—820 ohm, 1 w. res.
R_{14}, R_{15}—47,000 ohm, 1 w. res.
R_{16}—1 megohm, ½ w. res.
R_{18}—5600 ohm, 1 w. res.
R_{19}, R_{20}—18,000 ohm, ½ w. res.
R_{22}, R_{24}—82,000 ohm, ½ w. res.
R_{27}—290 ohm, 1 w. res.
R_{30}—3600 ohm, ½ w. res.
R_{37}—56 ohm, ½ w. res.
R_{39}—470 ohm, ½ w. res.
R_{40}—24,000 ohm, 2 w. res.
R_{42}—5000 ohm, 5 w. res.
R_{43}—6000 ohm, 2 w. res.
R_{45}, R_{50}—500,000 ohm dual pot
R_{46}, R_{48}—1 megohm linear taper pot
R_{49}, R_{50}, R_{52}—100,000 ohm, ½ w. res.
R_{51}—3300 ohm, ½ w. res.
R_{53}—22,000 ohm, ½ w. res.
R_{54}—2200 ohm, ½ w. res.
C_1, C_6, C_{10}, C_{14}—50 μfd., 25 v. elec. cond.
C_8, C_{12}—.1 μfd., 400 v. cond.
C_9, C_{18}—1 μfd., 200 v. metallized cond.
C_{11}-C_{17}—40/40 μfd., 330 v. elec. cond.
C_{13}, C_{19}—.5 μfd., 400 v. metallized cond.
C_{20}, C_{21}, C_{22}—.05 μfd., 400 v. cond.
C_{23}-C_{25}-C_{26}—20/20/20 μfd., 450 v. elec. cond.
C_{24}, C_{28}—.002 μfd. mica cond.
C_{27}—.02 μfd., 400 v. cond.
C_{29}—.0002 μfd. mica cond.
T_1, T_2—Input trans. 50 ohms to single grid (UTC A-10 or A-11)
T_3—Interstage trans. Single plate to push-pull grids, split secondary (UTC HA-106)
T_4—Output trans. push-pull plates to 500 ohm line (UTC HA-114)
T_5—Power trans. 240-0-240 v. @ 40 ma., 6.3 v.c.t. @ 2 amps; 5 v. @ 2 amps. (Thordarson TS-24R00 or equiv.)
CH_1—7 hy., 30 ma. choke
M_1—Vu meter (see text)
S_1—S.p.s.t. toggle switch
S_2—3 p. 3t. rotary switch
S_3—S.p.d.t. toggle switch
V_1, V_2—6J7 tube (1620 preferred)
V_3, V_4—12AY7 tube
V_5—5Y3GT tube V_6—12AU7 tube

preference to the 12AY7 for the equalizer. The circuit of this altered section is included in the diagram.

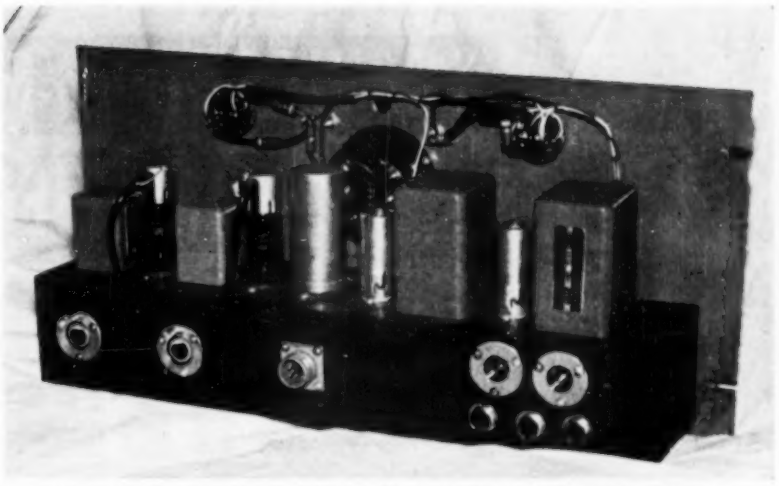
As previously mentioned, while there is no interaction between the four channels, there was some between the channel potentiometers and the master gain control. This was eliminated by feeding the combined output of the four mixer potentiometers directly to the grid of the mixer-equalizer stage and by placing the master gain control in the grid circuit of the output stage. A double potentiometer is used to control the push-pull grids simultaneously, as shown in the alternative schematic.

The output of the unit was designed to feed either a tape recording setup with a 500-600-ohm line bridging input or a 16 mm film recorder with a 50-ohm line input. To avoid complicated switching of the output transformer secondary taps, a simple matching pad was placed on a switch on the output, so that switching from "tape" to "film" automatically adjusts the output impedance. It is evident that this pad causes a loss of output level of about 16 db; however, the film recorder in question had ample gain and the loss was not important. Using the pad permitted the vu meter to work across a 500-ohm line at all times. In addition, the pad has the effect of terminating the line, even when the output is disconnected. Thus, rehearsals can be run while feeding only a bridging monitor amplifier having a 20,000-ohm input.

The vu meter can be switched off during preliminary set-ups so that accidental jolts while moving the microphone will not damage the needle. The 3600-ohm resistor in series with the meter is the standard calibrating resistor usually used with vu meters. If variation in output level is required, or changes in meter range are desirable, this resistor can be replaced by a 7500/3900-ohm variable pad to extend the meter scale. Such pads are available from the manufacturer of such meters.

In this article great emphasis has been placed on instability and the causes and cures for it. This may come as a surprise to those audiophiles who are not accustomed to the extremely high-gain circuits used in recording work. The tube complement is based on the use of low-noise types throughout. If 6J7's are used instead of 1620's, it may be necessary to select the quietest from a number of tubes. The same thing applies to the 12AU7 if substituted for the 12AY7 in the mixer stage. The output stage should, in any case, be a 12AY7. The 12AX7 is not a good substitute due to its higher mu and plate resistance. The over-all gain of the unit is such that the thermal agitation noise of the first stage sets the limit on following amplification. If all recommendations are followed, this hiss should be stronger than any other noise, residual hum, etc.

The power supply, which is not shown in the photographs, should be built on a separate chassis and the same rule that applies to the mixer followed here. Ground the chassis at only one point and do not ground the center tap of the heater circuit. The power supply should be kept as far from the mixer unit as possible. If this is not feasible, it may be necessary to use triple-shielded input transformers.



Rear view of unit. Note particularly the type of jacks and plugs that were used in the construction of this unit. It is important that all of these components be of the shielded type to prevent hum pickup. The jacks and plugs are, from left to right: Mic. 1, Mic. 2, power cable connector, (far right, top) 50 and 500 ohm outputs, (far right, bottom) Phono 1, Phono 2, and tape playback inputs.

If the power supply can be isolated the power transformer lead shown as shielded and grounded can be omitted. Many transformers are made today without this shield. Should your unit not come so equipped, you can ignore this requirement—*if the power supply is isolated.*

Just a few final suggestions regarding the construction before you whip out your soldering iron and start to build this unit. In the interests of economy and to avoid purchasing unneeded components, decide at the start whether for your purpose the original circuit, shown in the schematic, is to be used or whether one or both of the alternate circuits are to be incorporated. Some of the parts specified in the original diagram will be omitted if one of the alternate circuits is used and *vice versa.*

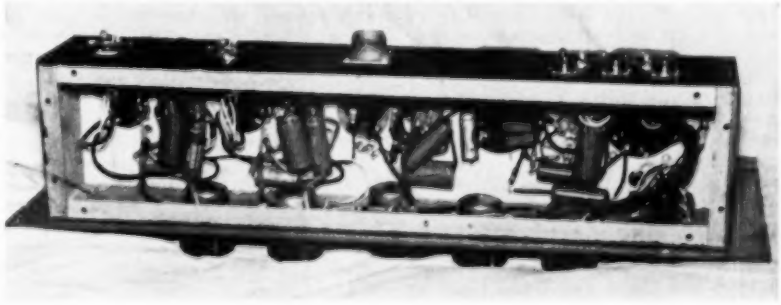
Another point which cannot be emphasized too strongly is the matter of grounding discussed earlier. If you are seeking trouble-free performance from this unit, it is imperative that the author's suggestions be followed to the letter.

It goes without saying that in this application, at least, quality transformers will have to be used. The builder will find that compromises are too expensive in the long run to be afforded. Just keep in mind that this circuit incorporates only four audio transformers which are doing the duty of the eleven units normally encountered in commercial versions of four-channel audio mixers.

This is one instance when "bargain" transformers will prove to be no bargain and the prospective builder will do well to stick to quality components. The transformers specified in the parts list are recommended by the author as they have proved entirely satisfactory in this application. Use units of similar quality for best results.

While all of these precautions may sound like undue "fussing" to the novice builder of audio gear, they are being handed along as "gospel" by one who has been through the mill. Good luck in building this unit. It is well worth the effort. —30—

Under chassis view of mixer. Wiring is critical so check author's suggestions regarding grounding and the location of such ground points before construction.



SERVICING HI-FI AMPLIFIERS

Fig. 1. Using an audio oscillator and a vacuum-tube voltmeter to measure an audio amplifier's performance.

By **DAVID FIDELMAN**
Author of "Guide to Audio Reproduction"

If you know some special techniques and how to talk the customer's language, you qualify as a specialist.

WITH the tremendous increase in the sales of all types of high-fidelity equipment, the maintenance and repair of this equipment can become a major source of income for the radio service technician. However, many high-fidelity enthusiasts are often dissatisfied with the type of service they obtain when they call in the average radio repairman. The major reason for this attitude seems to be that they feel their problems and requirements are not thoroughly understood.

The high-fidelity enthusiast—even the layman with no technical background, but just a general acquaintance with the technical aspects of sound reproduction—is aware of the many factors that are important in determining the quality of sound reproduction. When his equipment is installed or serviced, his main requirement is that it should sound good to the ear. But he also attaches considerable importance to such factors as harmonic and intermodulation distortion, frequency response, noise level, etc. These factors are major considerations in the initial sale of audio equipment (especially of the audio amplifier), and they should be given careful consideration in the service of such equipment and in discussions of how well it has been repaired after any failure.

The radio service technician can, of course, repair most failures of hi-fi audio amplifiers because of his experience in radio servicing, but there are important differences in approach and techniques which must be thoroughly understood if the customer is to be completely satisfied. The purpose of this article is to show the major differences between the servicing of high-fidelity amplifiers and other types of equipment, and to describe the procedures and techniques which are used.

Testing Amplifier Performance

One of the most important considerations in the testing of sound systems is that the audio signal can be seen on an oscilloscope, so that the experienced eye can tell from the oscilloscope trace exactly what the ear will hear. However, the actual sound signal is much too complicated to be analyzed by the eye. Therefore, for measurement purposes, a steady sine wave (or a simple combination of sine waves) is generally fed to the audio amplifier, and the output is studied for those characteristics which are important to the ear. These characteristics of the signal can be observed directly from the oscilloscope trace or measured from the signal itself by the proper instruments.

A number of measurements are necessary to insure that the unit is in proper operating condition. A casual listening test will not tell much about the over-all performance of a high-fidelity amplifier for all types of sound reproduction. An amplifier may be repaired superficially and still not be operating at its optimum level. There may be defects in its operation which would show up only on certain types of sounds, or as listening fatigue after long periods of listening.

After any audio amplifier has been repaired and is considered to be operating properly, some measurements should be made of the following characteristics:

1. Frequency response (with tone controls set at flat and at extreme positions)
2. Harmonic distortion with tone controls in flat position
3. Maximum power output
4. Noise level

The specified values of these characteristics for any particular amplifier are available from the manufacturer. If the measured values are close to the manufacturer's specifications, then the amplifier can be safely assumed to be in proper operating condition. If these specifications are not available, then the typical maximum values given in Table 1 may be used as a guide in determining the performance of the amplifier.

Some specialized pieces of test equipment are needed for proper servicing of audio amplifiers over and above the standard ones used in other types of servicing. The basic units required for this work are a volt-ohm-milliammeter, a sine-wave oscillator (20-20,000 cps or greater range, low distortion), a vacuum-tube voltmeter (minimum sensitivity of 30 millivolts full-scale deflection on most sensitive range), an oscilloscope (minimum sensitivity 0.04 volt r.m.s./inch vertical deflection, minimum vertical frequency range 15 to 100,000 cps), and a distortion meter. The harmonic distortion analyzer may not be strictly necessary, since distortion can be observed visually on the oscilloscope. (In fact, with experience, as little as 2 per-cent harmonic distortion can be detected in the oscilloscope trace.) However, the distortion meter should be used for thorough and quantitative

measurements, especially if performance figures are to be discussed with the customer.

The distortion meter measures the amount of spurious harmonics introduced into a pure sine wave due to the amplitude nonlinearity of the amplifier. The basic method of performing this measurement is shown in Fig. 2. A steady single-frequency sine wave (known to be relatively free from distortion) of known amplitude is fed into the amplifier from the signal generator, and the distortion meter connected to the output at the load resistor or loudspeaker. The meter contains a rejection filter which removes the fundamental and passes all the harmonics, and a vacuum-tube voltmeter which can be switched to measure either the fundamental plus harmonics or the harmonics only. The distortion is the percentage of harmonics introduced by the amplifier into the pure tone.

Intermodulation is also used as a measure of the performance of an amplifier. Two signals of different frequencies are fed into the amplifier, and the amount by which the low-frequency signal modulates the high-frequency one is measured. However, this distortion is produced by the same amplitude nonlinearity which causes harmonic distortion, and is therefore not a necessary servicing measurement if the harmonic distortion is measured.

Servicing Procedure

The basic technique of audio servicing and the manner in which it differs from other types of service work can best be understood by considering the actual service procedure for a typical high-fidelity audio amplifier.

Assume that a system which includes the amplifier of Fig. 3 requires service due to excessive distortion in the sound from the loudspeaker at medium-high levels for any setting of the input selector switch. The failure is obviously not in the input transducers since it is not likely they have all failed at the same time. The loudspeaker and the wiring to the loudspeaker are tested by disconnecting the output leads from the amplifier terminals and connecting them (through a matching transformer, if necessary) to the output of an audio oscillator set to a frequency of 400 or 1000 cps. If this results in an acceptable output sound from the loudspeaker, it indicates that the failure is in the amplifier.

For testing and repair, the inputs and outputs are disconnected and the amplifier is completely removed from the system.

Check first the various "B+" voltages to see whether the distortion is due to a failure in the signal circuit or in the power supply and decoupling circuits. Assume that in this case, touching the voltmeter first to the 5Y3 rectifier filament, then to the various filter and decoupling electrolytics,

CHARACTERISTIC	INPUT SIGNAL	OUTPUT SIGNAL	LIMITS	
			Good Reproduction	Acceptable Reproduction
Frequency response	Steady sine wave	Steady sine wave	20-14,000 cps	40-10,000 cps
Maximum power output	Steady sine wave	Steady sine wave	Depends upon individual unit. (Typical requirement is 5-10 watts.)	
Noise level	No signal	Random noise or hum	-60 db below full output	-50 db below full output
Harmonic distortion	Steady sine wave	Fundamental plus harmonics	1% total harmonics	2-4% total harmonics

Table 1. Typical amplifier specifications and the maximum allowable distortions, useful as a guide for servicing when data is not available for an amplifier.

shows that there are proper "B+" voltages at all these points in the circuit.

The power supply is, therefore, in order. Since the excessive distortion may be due to a number of different failures in the signal circuit, the best method is to use the direct approach and trace a signal through the circuit from the input to the point where the distortion occurs. (This method may actually be faster in locating tube failures than the use of the tube tester, but it is always desirable to check all tubes in order to replace those which are weak and can be expected to fail soon.)

A signal generator, set for a frequency of 1000 cps and an amplitude of about 2 volts r.m.s., can be connected directly into the high level input of the amplifier without any impedance matching since the input impedance of the amplifier at this point is 500,000 ohms. A loudspeaker or an 8-ohm, 10-watt resistor is connected

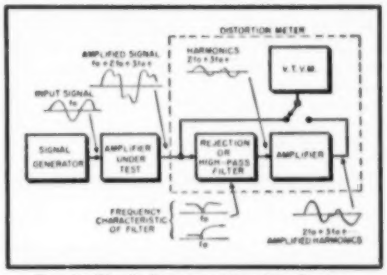


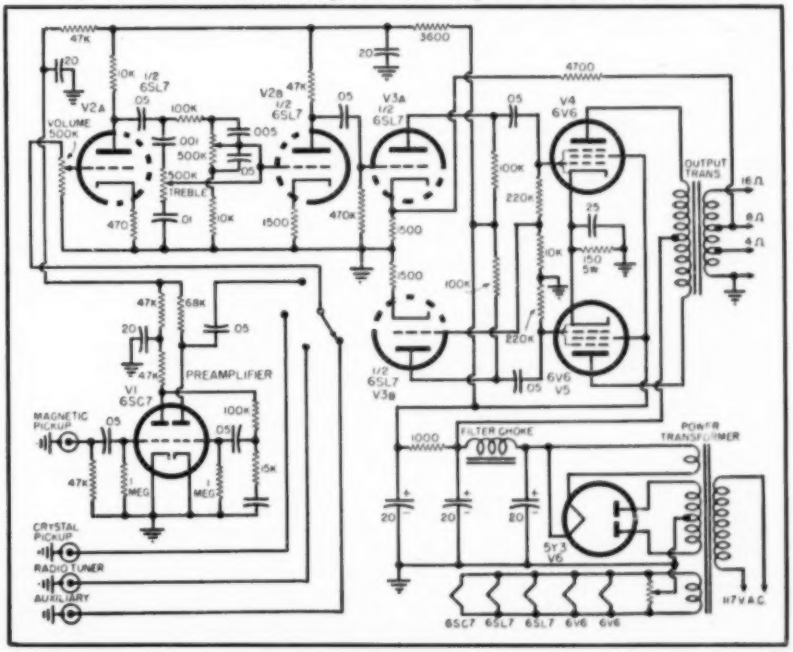
Fig. 2. Block diagram showing the use of a distortion meter to measure the harmonic distortion of an amplifier.

across the output terminals for proper termination of the output.

The signal is then traced through the circuit by observing it with the oscilloscope. It is checked for proper level, gain in each stage, and lack of distortion. With a 2-volt signal at the input and the volume control set in its normal position, there is a 0.25-

(*Continued on page* 126)

Fig. 3. Schematic diagram of a typical high-fidelity audio amplifier and preamp.



By BERT WHYTE

THE prologue this month is going to be very short. There are so many good LP's to tell about, I need extra space. In this connection, you have probably noticed we are now using a much smaller type face. This smaller type will allow an approximate 30 per-cent expansion of "Certified Record Revue," and will enable me to bring more of the ever increasing flood of long-play records to your attention. I will continue the tape reviews which were instituted last month, and will bring you a report on what was new, novel, and nifty at the NY Audio Fair, in an early issue.

Equipment used this month: New *Weathers* A-510 pickup, arm, and oscillator, *Rek-O-Kut* T12H turntable *McIntosh* C-108 preamp, two 30-watt *McIntosh* amplifiers, one *Jensen* "Triaxial" in *Jensen* folded horn, one *Jensen* "Triaxial" in *Karlson* enclosure. *Concertone* 1502 tape equipment.

WILLIAMS, RALPH VAUGHN
JOB
London Philharmonic Orchestra conducted by Sir Adrian Boult. London LL1003. RIAA curve. Price $5.95.

London issued this disc without any fanfare and it arrived in the mail quite unexpectedly. This is rather puzzling to me, in the light of the fact that this is one of Vaughn Williams greatest scores and the fact that it would have tied in so well with the recent album of the complete symphonies of this master, as issued on *London*. Well, if *London* won't shout about this recording, I'll do it for them! This record is worthy of every laudable adjective you can think up. Seldom has a phonograph record been so completely satisfying. From every aspect, one of the great recordings of the LP era. The music? Simply fabulous. One of the most profoundly beautiful and "listenable" of all modern compositions. If you've never cared a toot about Vaughn Williams, this will change your mind, in a big hurry! The score has been used as a ballet, but is really at very wide variance from the accepted idea of a ballet score. Inspired by Blake's illustrations for the Book of Job, this is one of the most intensely dramatic works ever written. Following the traditional story of the trials and tribulations of Job, Vaughn Williams has used nine "scenes" to describe the Blake paintings, and in so doing has written some awe-inspiring music, music which glitters with the many facets of Williams' great talent. The sound is in keeping with the music. Some of the very best *London* has ever recorded. Strings are clean and incisive and the sonorities generated by contrabass and brass are fantastic. In the scene #6, entitled "Dance of Job's Comforters," Job curses God and God reveals Satan and the hosts of Hell. The music to illustrate this is overwhelming in its impact. The string section in ascending figures leads to a tremendous crashing series of chords for orchestra and organ, there is an ominous pause and then the whole mighty weight of the orchestra, of bass drums and tympani, cymbals, brass, strings—*everything*—explodes in an awesome torrent of sound. This will positively give you goose pimples! Played through a big speaker system, the effect is shattering, and I warn you to be careful of gain. Other sections of the work are equally exciting, with great dynamics and sound throughout. A recording no serious audiophile can afford to miss! The RIAA curve was better sounding with a couple of db bass boost. Quiet surfaces.

SAINT SAENS
CARNIVAL OF THE ANIMALS
IBERT
DIVERTISSEMENT
Concert Arts Orchestra conducted by Felix Slatkin. Capitol P8270. RIAA curve. Price $5.70.

Two lively contributions from the excellent Concert Arts Orchestra which seems destined for "demonstration repertoire." At least that is the kind of stuff *Capitol* has been recording with this group, as witness the recent "Mask of the Red Death" and other works in similar idiom. The Saint Saens is given the straight orchestral treatment here. No urbane Noel Coward sullies this hi-fi hijinks. Indisputably the best version of this amusing score, with splendid playing and superb sound. I should qualify the statement about the sound by advising you that this good sound cannot be obtained unless the treble is reduced a few db from the prescribed curve. For some strange reason, this record has strings which, while clean, are quite thin and strident sounding, even though all other choirs such as brass, woodwind, etc. seem perfectly balanced. Play it with the RIAA curve and it's a little tough on the ear. Cut the treble and the db's sit up and behave, and we have a really fine sounding record. You run across one of these puzzlers every now and then! The Ibert is typical of this composer, witty, satirical music which lends itself well to hi-fi treatment. In the section called "Cortege" there is a brief parody of the Mendelssohn "Wedding March" complete with trombone giving forth with a horse-laugh and it's really quite a how!! Slatkin seems to know his way with these scores and elicits very slick, well polished performances from his men. Typical quiet *Capitol* surfaces.

RAVEL
DAPHNIS AND CHLOE SUITES #1 AND #3
ALBORADA DEL GRACIOSO
Orchestre National de la Radiodiffusion Francaise with Chorale Marcel Briclot conducted by Andre Cluytens. Angel 35054. RIAA curve. Price $5.95.

Until the advent of this recording, we had available seven versions of the popular Suite #2 and only one (Ormandy-*Columbia*) version with both suites. Maybe I'm all wet, but it seems to me that the way to hear this work and get the most out of it, is to hear it complete . . . both Suites including the Choral part. The Ormandy of a couple of years back illustrated this pretty clearly and was certainly the preferred reading. This present recording brings us superior sound and the keener insight of Cluytens. His is a reading which emphasizes the poetry and grace, the lyrical elements, without sacrificing the headstrong dynamics which give this work its power and texture. Soundwise, this is an extraordinary disc. At first hearing you may not be overly impressed. I think this is because we are *consciously* listening for super-spectacular hi-fi pyrotechnics in this work. Hi-fi this record most certainly is . . . but the combination of wide range, good dynamics and the superb balance of the individual choirs is so smooth that it is unobtrusive. This is sound that is translucent rather than incandescent, and frankly is somewhat of a relief from screechy rasps being purveyed as "hi-fi" sound by some companies. The "Alborada Del Gracioso" receives a vigorous, well integrated reading. The sound on this is not as effective as the "Daphnis," calling for the more supercharged variety furnished by the Dorati-*Mercury* version of a few years ago. Cluytens has done a remarkable job with his orchestra, which is evident from the really splendid performance. A top notch disc and a good buy. The "factory sealed" *Angel* package made possible an exceptionally smooth, silken surface, with a minimum of "popping" and "snapping."

TCHAIKOVSKY
SYMPHONY #6 (PATHETIQUE)
Pittsburgh Symphony Orchestra conducted by William Steinberg. Capitol P8272. RIAA curve. Price $5.70.

I can hear you groaning, "What? *Another* Pathetique!" Yessir, you are right. The *fifteenth* version, to be exact! The duplication sweepstakes is still going strong. I've yakked for pages about the duplication problem, and I can offer no encouragement about its eventual solution. Remember this one thing, however. *Duplication is a product of the record-buying public!* If a company puts its best foot forward and offers "new" repertoire, more often than not, the public rejects it and the resulting red ink is a potent reminder to the company not to stray from the straight and narrow. Then, too, every conductor has his adherents. You may think Toscanini or Kubelik or Ormandy is the last word on the "Pathetique." But quite a number of people don't happen to agree with you and have been waiting breathlessly (?) for Stokowski's version or, as in this recording, Steinberg's reading. The record companies know this, and they always figure there are enough champions for their particular boy to make the venture pay off. Don't ask me what happens when the companies run out of people! Getting back to this recording, it has much to offer. Steinberg essays a straightforward, well balanced reading with the tempi a mite on the slow side. This makes for a most eloquent and expressive final movement, full of dark pathos, and is the high point of Steinberg's performance. The sound is in keeping with the reading; not as fussily detailed as some, but rather a "big hall-over-all" type, with exceptional balance. String tone is clean, especially celli and contrabass, brass and percussion bright but not spectacular. Woodwind reproduction is very effective. The orchestra plays particularly well, and it is evident that Steinberg and his men are by

(*Continued on page* 173)

The opinions expressed in this column are those of the reviewer and do not necessarily reflect the views or opinions of the editors or the publisher of this magazine.

Motorola 19-inch color TV set priced at $895.

FUNDAMENTALS OF COLOR TV

R-Y & B-Y DEMODULATION SYSTEMS

By MILTON S. KIVER*

Part 9. Concluding article analyzes a color TV receiver which uses R-Y, B-Y demodulation rather than I and Q.

THE color television receivers which have been produced to date can be divided into two categories: those which utilize the full color signal to develop a picture on the screen and those which use only part of the color information. We have, in previous articles, discussed receivers in the first category. In the present article we will turn our attention to receivers in the second category.

By way of review, we have seen that a complete color signal consists of the following:

1. A monochrome signal with components that extend from 0 to 4 mc. This is the *Y* signal.

2. A color subcarrier whose frequency is set at 3.58 mc. (actually it is 3.579545 mc.).

3. This color subcarrier is modulated by two color signals called the *I* and *Q* signals.

4. The *Q* signal has color frequencies that extend from 0 to 500 kc. or .5 mc. This means that the upper *Q* sideband extends from 3.58 mc. up to 3.58 + .5 or 4.08 mc. The lower *Q* sideband goes from 3.58 mc. down to 3.58 −0.5 or 3.08 mc.

5. The *I* signal has color frequencies that extend from 0 to 1.5 mc. When this modulates the color subcarrier, upper and lower sidebands are formed. The lower sideband extends from 3.58 mc. down to 3.58 −1.5 or 2.08 mc. If the full upper sideband were permitted to exist, it would extend all the way up to 3.58 + 1.5 or 5.08 mc. Obviously this would prevent the use of a 6 mc. over-all band for the television signal (video and sound). To avoid this spilling over beyond the limits of the already established channels, the upper sideband of the *I* signal is limited to about .6 of a megacycle. This brings the upper sideband of the *I* signal to 4.2 mc.

The need for two color signals of unequal bandwidth stems from the color characteristics of the human eye. Three primaries are required only for relatively large colored areas or objects. On a television screen, these are the objects produced by video frequencies from 0 to .5 mc. For medium-sized objects (those produced by video signals from .5 to 1.5 mc.), the eye is sensitive only to bluish-green or reddish-orange. The NTSC signal, *via* its *I* component, is fashioned to take advantage of this characteristic.

We know that when we present all the color of which the NTSC signal is capable, a very pleasing picture is obtained. Just how much less color the eye can take in a picture and still be satisfied is as yet unknown. However, some color receiver manufacturers have designed (and produced) color sets in which the bandpass of the color signal is limited to about .5 or .6 mc.

Here is the basis for this action. A color picture signal can be represented by the following equation:

$$E_T = E_Y + E_Q \sin(\omega t + 33°) + E_I \cos(\omega t + 33°) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

The E_Y term, of course, represents the monochrome portion of the signal. The E_Q and E_I represent the color voltages. Since E_Q is multiplied by $\sin(\omega t + 33°)$ and E_I is multiplied by $\cos(\omega t + 33°)$, the E_Q and E_I signals are 90° out-of-phase with each other. (Sine and cosine functions are 90° out-of-phase with each other.) This, of course, is well-known by now.

If we now limit the color video frequencies to a maximum of .5 mc., it can be shown that equation (1) becomes:

$$E_T = E_Y + .492\,(E_B\text{-}E_Y) \sin \omega t + .877\,(E_R\text{-}E_Y) \cos \omega t \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

EDITOR'S NOTE: *Part 1 of this series, which appeared in the March, 1954 issue, explained color mixing and its application in color TV. Part 2, appearing in the April issue, described the NTSC color signal. The block diagram of a typical color TV receiver was described in the May issue. The June article in this series described the tuner, sound, and some of the video circuits of a color receiver. Typical chrominance circuits (demodulator, matrix, adders, etc.) were analyzed in the July article. The formation and composition of the color signal were explained in August. Color synchronization circuits including the subcarrier oscillator were analyzed in September; deflection and high-voltage circuits in October. This month's article concludes this series, however, forthcoming issues will contain articles by Milton S. Kiver on servicing of color TV receivers.*

RADIO & TELEVISION NEWS *has published this series in reprint form. The first three parts are in a single unit (50 cents), the balance are reprinted in individual parts at 20 cents each. For quantities of 50 or more, write for quotations. Address your inquiries to* RADIO & TELEVISION NEWS *Reprint Editor, 366 Madison Ave., N. Y. 17, N. Y.*

* Author of "Television Simplified," "Television and FM Receiver Servicing," and other books.

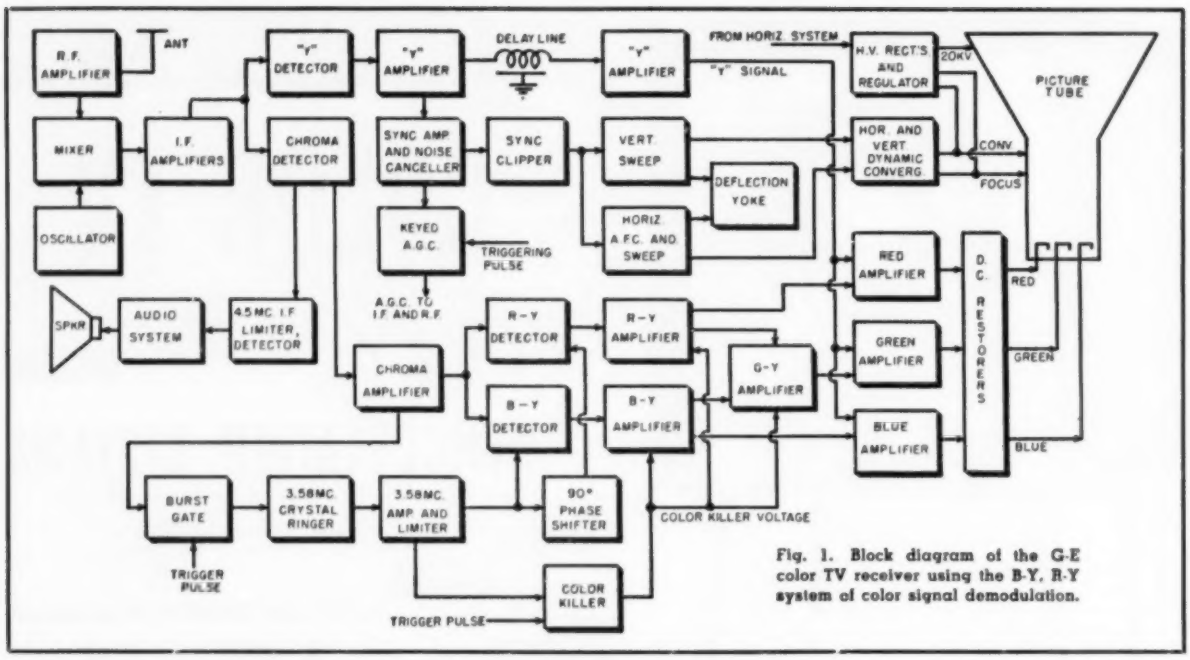
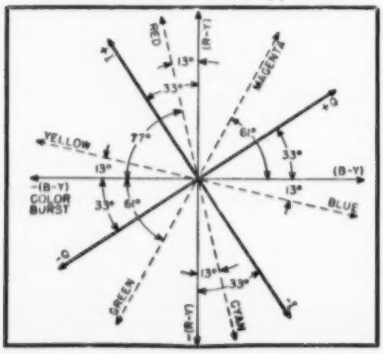


Fig. 1. Block diagram of the G-E color TV receiver using the B-Y, R-Y system of color signal demodulation.

E_Y remains unaltered since nothing has been done to affect it. However, in place of E_Q we now have E_B-E_Y and in place of E_I we have E_R-E_Y. Also, we note that E_B-E_Y is multiplied by $sin\ \omega t$ instead of $sin\ (\omega t + 33°)$. Therefore, E_B-E_Y is shifted 33° from the E_Q position on the color phase chart. See Fig. 2. The same situation is true of E_I and its replacement E_R-E_Y. Thus, if you take an incoming color signal containing E_I and E_Q voltages and shift the phase of the re-inserted carrier by 33°, you obtain (at the output of the demodulators) E_R-E_Y and E_B-E_Y signals.

This, then, is the basis of color receivers which have their color bandpass restricted to .5 mc. All large detail in a picture produced by such a receiver would be colored in the same way and to the same extent as in an I and Q demodulator system. However, above .5 mc., all detail in the picture is in black and white (or monochrome) and so we can say that the over-all picture is less colored in an E_R-E_Y, E_B-E_Y system than it is in an I and Q set.

Fig. 2. Color phase diagram showing the position of the B-Y and R-Y vectors relative to the I and Q vectors.



At this point, the reader might very well ask, "Why use the modified system if it provides less color in the picture?" The answer, supposedly, lies in certain economies which can be effected in the E_R-E_Y, E_B-E_Y method. Whether or not this is so—and there is considerable difference of opinion on this point—our primary interest is circuit design and this will now be examined.

The block diagram of an R-Y, B-Y color receiver is shown in Fig. 1. The r.f. and video i.f. sections are similar to those of other color receivers discussed in previous articles. The gain of the r.f. tuner and the i.f. stages is controlled by an a.g.c. voltage derived from a conventional a.g.c. keyer tube.

The video i.f. system feeds its signals to two separate detector circuits. One detector is designated as the Y detector and its output consists of the usual monochrome video and sync information. The Y detector output is applied to a cathode follower, which transfers the video signal to two Y amplifiers and beyond this to the color circuits for combination with the R-Y and B-Y voltages. A 1 microsecond time delay network between the first and second Y amplifiers slows down the monochrome signal so that it is in step when it recombines with the color components in the matrix. (The latter, as we shall see, is considerably less complex in these receivers than in I and Q sets.)

The Y detector also provides the signal for the receiver's sync system. The second of the two detectors is the chrominance (chroma) detector and it delivers two output signals. One signal is the conventional 4.5 mc. intercarrier sound i.f. signal which is then passed, in turn, to a 4.5 mc. amplifier, a limiter, a ratio detector, and two audio amplifiers in the usual manner. The other signal is the color signal and it is applied to a chroma amplifier. See Fig. 3. At the output of this amplifier, the signal is applied to two separate sections of the color system. Part of the signal goes to a burst gate amplifier. The other portion is transferred to a chroma cathode follower and from here to grid 3 of the 6BE6 R-Y and B-Y detectors. A chroma control in the cathode leg of the cathode follower stage is mechanically ganged to the contrast potentiometer in the Y cathode follower circuit so that both the Y and color signals will be similarly affected when the controls are rotated.

The burst gate tube is normally biased to cut-off. However, during the horizontal retrace interval, it is driven into conduction by a pulse obtained from a winding on the horizontal output transformer. The tube conduction period lasts just long enough to pass the color burst. After this, the pulse disappears and the burst gate amplifier lapses back into cut-off.

The color burst which the burst gate amplifier passes is used to shock-excite a crystal ringing circuit. The oscillations are amplified, then limited, and finally transferred to the R-Y, B-Y detectors. A 90° phase-shifting network in the plate circuit of the limiter provides the two demodulators with 3.58-mc. signals that are 90° apart. A prior hue control, in the output circuit of the amplifier, permits the set owner to make a limited correcting adjustment in the phase of the generated 3.58-mc. oscillations. The control is set to natural flesh tones.

The two color detectors, Fig. 5, now have all of the ingredients needed to

recreate the demodulated color video signals. The output circuits of both 6BE6's are almost identical because both color systems now have the same bandpass, 0 to .5 mc. (In practice, the bandpass frequently extends a little more than this, perhaps to .6 or .7 mc.) This arrangement obviates the need for any special delay lines in the color circuits; the only delay line in the receiver is that found in the *Y* section.

The *R-Y* and *B-Y* detectors are each followed, in turn, by an amplifier and then the signals are divided between two separate signal paths. First, portions of the output voltages from both amplifiers are fed to a simple resistive adder (R_1, R_2, and R_3) to form a negative *G-Y* signal. This is possible because, as shown in Part 2 of this series,

$$-(G\text{-}Y) = .51\,(R\text{-}Y) + .19\,(B\text{-}Y)$$

The specific proportions are developed by the adder network and fed to a *G-Y* amplifier. Here the signal is inverted, giving us the needed *G-Y*. Now we have all three color-minus-brightness signals (*R-Y*, *B-Y*, and *G-Y*) and by simply adding $+Y$ to each, we obtain the original red, blue, and green video signals. The addition of $+Y$ takes place *via* R_4, R_5, and R_6 (Fig. 5).

The output section of the chrominance portion of the receiver consists of separate channels for the red, green, and blue color signals. Each branch has two amplifiers and a d.c. restorer. The amplifiers use degenerative feedback to reduce their input impedance and to enable the proper mixing action to occur between the color-minus-brightness signals and the *Y* signal.

A color killer circuit is also employed in this system to prevent the appearance of any spurious color signals when a black-and-white program is being viewed. The grid of the killer triode, Fig. 4, is connected to the grid of the 3.58-mc. limiter tube. When no color signal is being received, the 3.58-mc. crystal is quiescent and the grid-leak bias on the limiter tube is zero Under these conditions the color killer tube conducts whenever its plate receives a positive pulse from the horizontal output transformer. The resulting current flow develops a negative charge across C_1 and this, added to the -2.5 volts normally present across the condenser, is sufficient to bias all *R-Y*, *B-Y*, and *G-Y* amplifiers to cut-off.

When a color signal is received, the 3.58-mc. generated oscillations develop enough negative grid-leak bias on the limiter grid to cut off the color killer tube. This prevents the tube from conducting, even when pulsed, and the only negative voltage appearing across C_1 is the -2.5 volts from the receiver power supply. This voltage is not sufficient to prevent the color-minus-brightness amplifiers from operating.

The remaining circuits of an *R-Y*, *B-Y* receiver are similar to those in *I*, *Q* receivers.

(EDITOR'S NOTE: With this article, we conclude the present series on color television receivers. Articles on the servicing aspects of color receivers will be presented by Mr. Kiver in subsequent issues of this magazine.)

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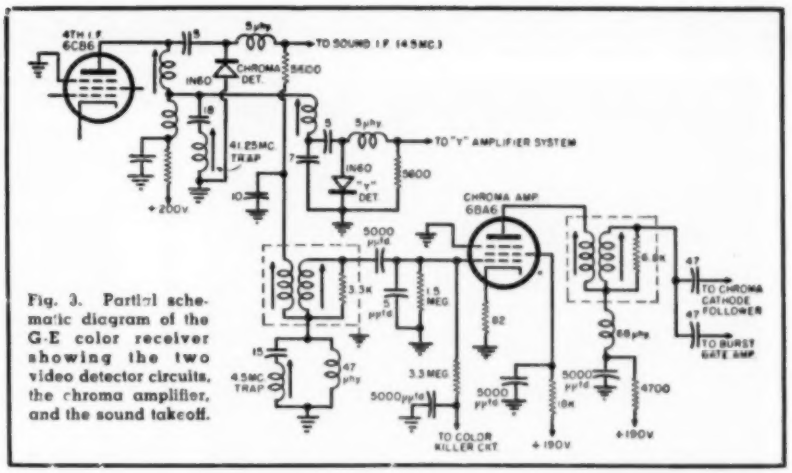


Fig. 3. Partial schematic diagram of the G-E color receiver showing the two video detector circuits, the chroma amplifier, and the sound takeoff.

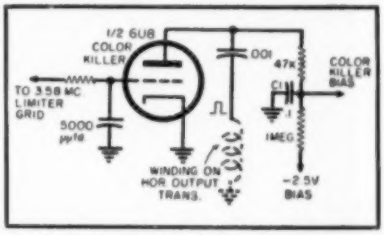


Fig. 4. Color killer circuit of the G-E set.

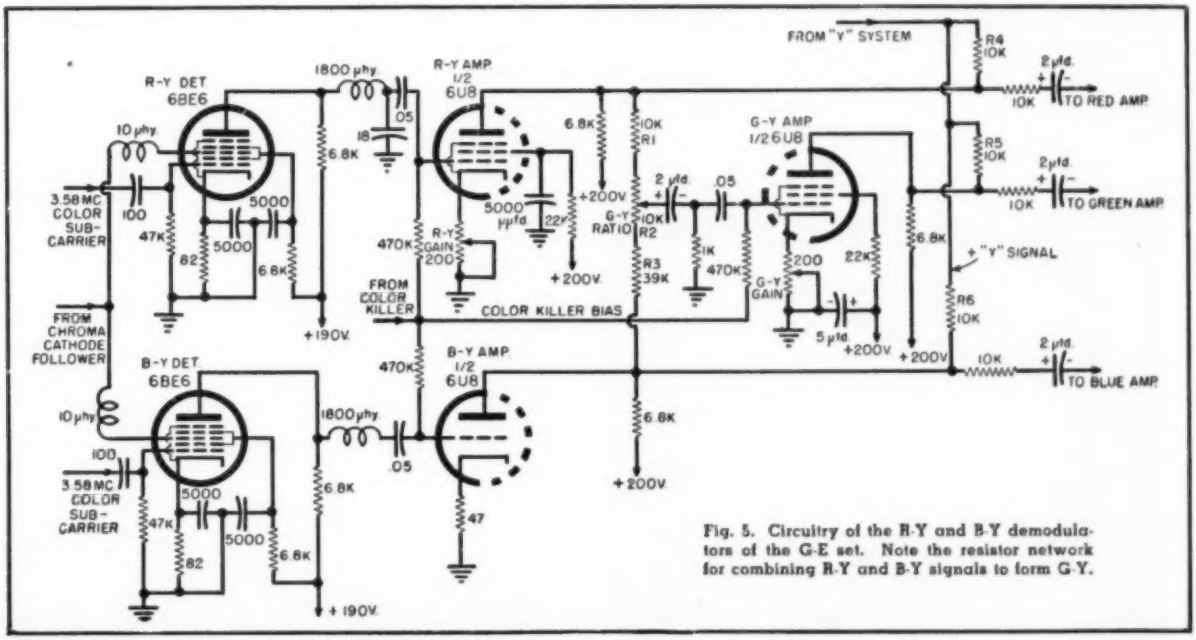


Fig. 5. Circuitry of the R-Y and B-Y demodulators of the G-E set. Note the resistor network for combining R-Y and B-Y signals to form G-Y.

THE ELECTRON TUBE

By

COMMANDER PAUL G. WATSON, USNR (Ret.)

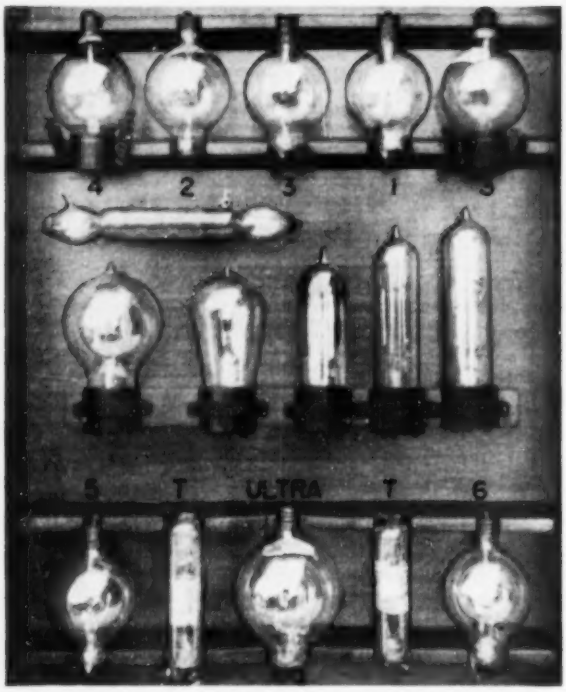


Fig. 1. Some original de Forest tubes. No. 1 is from 1907; No. 2 is of 1909 vintage; Nos. 3 and 4 appeared a little later than No. 2; Nos. 5 and 6 are 1910 models; while the "Ultraaudion" dates from 1913-14. The middle row of tubes are special transmitting tubes, referred to in text, made in 1915 in conjunction with Lt. Comdr. S. C. Hooper, USN. The "T" tubes (bottom row) are from 1915. Tubes identified by Dr. de Forest.

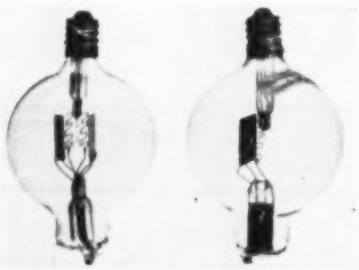


Fig. 2. The de Forest "Audion" of 1907-1909 (right) with a single plate and grid. An improved version of this tube (left) appeared in 1910. It had two plates and two grids. These spherical tubes measure approximately 4 inches from cap to base.

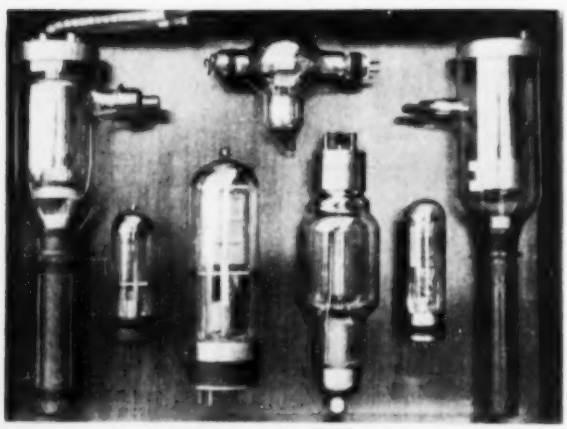


Fig. 3. Medium power tubes of the 1920's. (Right) The RCA UV 863 10 kw. water-cooled type; (left) Federal Telegraph F-863-A 10 kw. water-cooled; (top center) RCA 860. (Bottom center, left to right) Western Electric 211, 50 watt; W. E. 212 D, 250 watt used in almost all early broadcast transmitters; RCA 204, 250 watt tube used by many hams in early days of c.w. and phone operation; and RCA 203 50-watt tube—all in author's collection.

WHEN one considers the present scope of the electronics industry as a whole, its gigantic proportions and its ramifications ranging from an "electronic brain" to door openers, surgical instruments and communications, the question of how this great industry grew and whence it came are bound to come up. Who invented the electronic tube, and how was it discovered?

The author has, over a period of years, collected together such of the old tubes as could be obtained; from this collection he selected representative tubes typical of the development of tubes as they were available and has mounted them in exhibition cases. Pictures of this collection are shown herewith, since they illustrate the beginning of the electronic tube industry. It all began with Dr. Lee de Forest and his "Audion," as his three-element vacuum tube was called, in the year 1905.

About a year ago Dr. de Forest very kindly identified and dated for the writer, all of his tubes which are in this collection.

Experiments in Chicago in 1901 to 1903 had given Dr. de Forest an idea that incandescent gas had some value as a means of rectifying received radio signals to make them audible. In his laboratory on Thames St. in New York in the fall of 1903, Dr. de Forest put two platinum electrodes in a Bunsen burner flame and, with a battery and headphones connected to an antenna, succeeded in hearing radio signals from ships in the harbor.

Being convinced that the incandescent gases had much or all to do with the "translating" of the received signals to audible sound, Dr. de Forest and an assistant, Clifford D. Babcock, used a carbon arc lamp to produce incandescence, got signal reception, but with too much noise to be of practical use.

Next came the effort to use a carbon filament lamp, but because of their uncertain abilities as glass blowers results were a failure and disappointment.

However, in 1905 an incandescent carbon filament lamp with a platinum plate was constructed by H. W. McCandless at 67-69 Park Place, New York, to specifications provided by Dr. de Forest. This lamp was a success and was the first vacuum tube detector to use both filament

Dr. Lee de Forest and William Howard McCandless whose shop made all of the Audions from 1907-12.

From modest beginnings, a giant industry has grown up around de Forest's invention.

and plate batteries. This subsequently became a major point in litigation with the English "Fleming valve" interests wherein no "plate" battery was used, depending entirely on rectification of received energy for the audible signal. As augmented by de Forest's plate battery, a much stronger audible sound was produced, being partly battery and partly received energy.

Dr. de Forest realized at this stage of development that despite the fact that the diode worked, much of the energy received by the antenna was bypassing the tube through the headphones and battery. He wrapped the tube with tin foil which was then connected to the antenna and got better results. A second plate with the filament between the two was put inside and the results exceeded all previous experiments.

It was this device which was named "Audion" by Babcock, a name used to identify all de Forest vacuum tubes thereafter.

It was soon evident that the second plate, or control element (the grid), could be located more effectively between the plate and the filament, and so a small platinum plate with many perforations was prepared and another tube made with this inserted between the filament and solid plate. This was the first conventionally-arranged triode tube ever made. In subsequent (*Continued on page* 166)

Fig. 4. The UV-862 100 kw. water-cooled triode tube. The plate circuit ran 18,500 volts at 5 amps. Filament rating was 205 amperes at 32 volts. Tube was made by Radio Corp. of America.

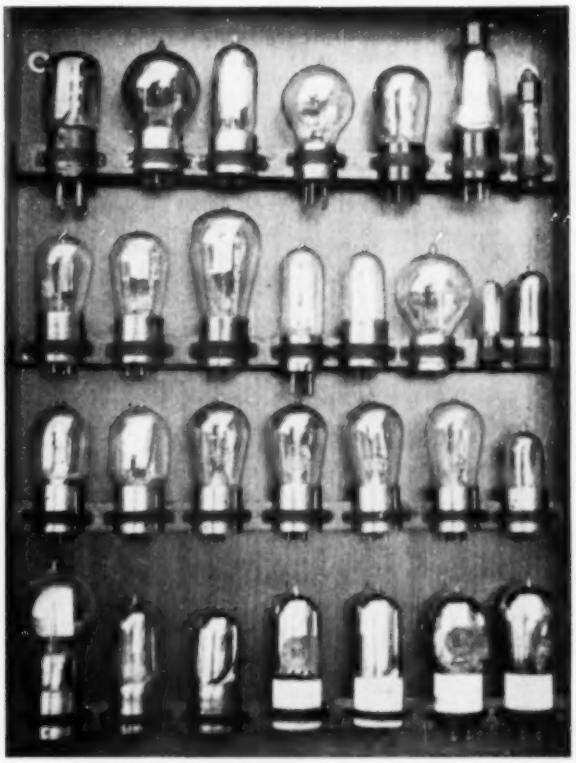


Fig. 5. Miscellaneous group of triodes dating from 1916 through 1921. (Top row, left to right) German Army tube, World War I; W. E. VT-2 5-watt transmitting, U. S. Army & Navy, World War I; W. E. VT-1 detector and amplifier, same period; Fotos, French tube, prototype for most foreign tube design; UX 225, experimental model of heater tube and predecessor of 227; McCollough heater-type with a.c. leads on top cap; Meyers detector and amplifier for amateur use (1920's) clips in cartridge fuse-type mount. (Second row) RCA UV 200 (early 1920's) "soft" detector; RCA UV 201 (early 1920's) "hard" tube for amplifier service; RCA UV 202, 5-watt transmitting tube, also used as first power amplifier in RCA line; RCA WD 11, detector and amplifier for use in early home b.c. receivers, filaments battery operated; RCA WD 12, similar to WD 11 but with standard four-prong base; W.E. CW 1344 used as detector and amplifier in commercial receivers (1917); RCA UV 199, detector and amplifier with low current filament for dry cell operation. (Third row) Moorhead tube, a detector and amplifier marketed under many names, including Marconi and de Forest; Electron Relay, a soft detector made by Moorehead; G-E TB-1 rectifier (1916-18); G-E CG 1162 pliotron (1916-18); G-E VT 14 pliotron (1916-18); G-E CG 890 pliotron (1916-18); W.E. VT 21 for U.S. Army (1916-18). (Bottom row) The de Forest "Singer" tube; OT-5 and OT-3 made by de Forest for O & T Electric Co.; DV-5, DV-3, DL-14, and D-01A "Audions" made by de Forest and dating from early 1920's.

AUDIO AMPLIFIER-PREAMP

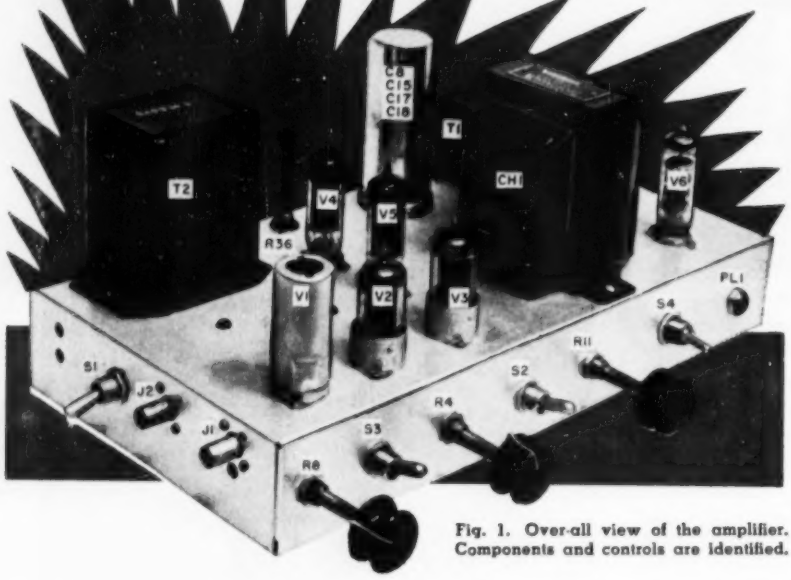


Fig. 1. Over-all view of the amplifier. Components and controls are identified.

THE amplifier to be described was built by the author in order to compare the listening qualities of a low-power unit in an average home with a high-quality 20-watt amplifier.

Initially, a test was run using a high-quality FM tuner tuned to a live performance of Beethoven's "Ninth Symphony." The tuner was fed into a *Williamson*-type 20-watt amplifier terminated in an equivalent speaker load resistance. An oscilloscope and an average-reading voltmeter were bridged across this load. A broadcast of a live performance was used in this test rather than a recording because, in general, FM stations broadcast with better frequency range and lower distortion than is generally available on even the better recordings.

The FM receiving system was such that the antenna was in a strong signal area and in a line-of-sight position from the transmitting tower. This insured that there would be no reflections from buildings and other objects that might cause multipath distortion at the input of the tuner. With this installation it was possible to receive practically the same quality signal as transmitted.

Home vs Concert Hall Listening

Before considering actual details on the amplifier it would be well to mention some of the factors which make home listening different from that in a concert hall. Perhaps the most important of these factors is compression of the volume range. Compression is used in both FM broadcasts and in commercial recordings. This is necessary since the volume range of the average symphony orchestra is so great that if the same range was reproduced in the home the lowest volume would be inaudible while the maximum volume would be ear-splitting.

While there have been volume expanders developed which give the inverse volume characteristic of the compressor, they have not been generally accepted for the reason cited. This leads to the conclusion that compression, although it does sacrifice some of the realism of the concert hall, is necessary in all wide-range sound brought into the home.

The tuner used in the test was a *Radio Craftsmen* RC-10 which, according to the manufacturer's literature, has a frequency response of $\pm$ ½ db over a range of 20 to 20,000 cps. This bandwidth is adequate to handle present-day commercial recordings and broadcasts. The distortion of the incoming signal, according to the manufacturer, is less than 1 per-cent.

Beethoven's "Ninth Symphony" was selected as the "test" selection because it has a volume range equal to or greater than that of almost any other piece of music and, in addition, has both solo and chorus voices.

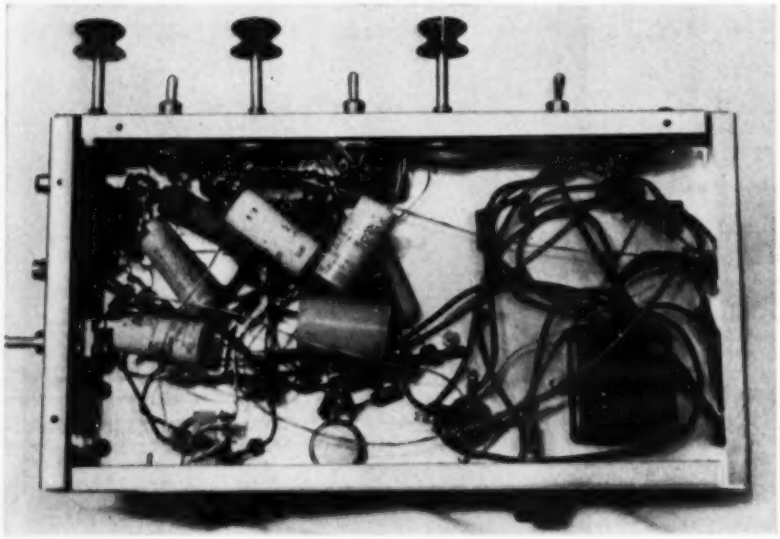
The *Williamson*-type power amplifier was used in this test as a standard since performance data indicated that it was one of the best units presently available.

The oscilloscope employed in making the tests was a *Heathkit* unit whose frequency response is flat from below 10 cps to over 1 mc., according to the manufacturer.

The power, P, is equal to E^2/R at the equivalent speaker load. It was found that the greatest peaks were no more than 18 times the average power. This was probably due to compression but since compression is a necessary feature of sound in the home, this figure was taken as the maximum ratio of peaks to average power. To round off the number and to give an added safety factor, let's call this figure 20.

In another test using an ordinary 8" speaker at normal home listening level, it was found that the average power into the speaker was approximately .25 watt. When the volume control was advanced so that the sound was loud enough to verge on the unpleasant, the average power into the speaker was found to be .4 watt. If we multiply this value by 20 we get the power of which the amplifier should be capable in order

Fig. 2. Underchassis view. Wiring should be direct and as short as possible.



FOR HOME USE

By **PHILIP CHEILIK**

Construction details on a compact unit providing 8 watts of undistorted power. It includes preamp and tone controls.

to give fidelity reproduction at the higher average level. Thus we see that the power needed for absolute fidelity in the home is 8 watts. Ordinarily in home installations the speaker system and the baffles can be arranged so that maximum advantage is taken of the acoustics of the room.

Another point in connection with these tests is that the highest peaks observed were all extremely narrow. If, for example, we had an amplifier which could only reach 15 times the average power without distorting, then as the peak power goes to the point where ordinary class AB_1 is exceeded, the grid current is drawn by the output tubes, causing the operation to be class AB_2. If this occurs in an amplifier designed for class AB_1 operation, the extreme peaks will be somewhat rounded.

If the peaks were clipped off, distortion would be quite noticeable. The rounding off, however, is not noticeable and the distortion, when integrated over any appreciable time, is seen to be very small. Thus, for quite good reproduction all that is needed is $(15/20) \times 8 = 6$ watts of undistorted audio from the amplifier.

Thus, in the author's opinion, an amplifier which can supply 6 to 8 watts of undistorted audio is sufficient for the average home. The amplifier to be described can deliver 8 watts of audio without overloading.

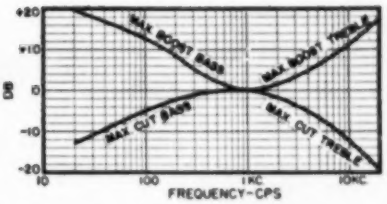


Fig. 3. Response of the tone control incorporated in amplifier. It is based on the original "Williamson" circuit of 1949.

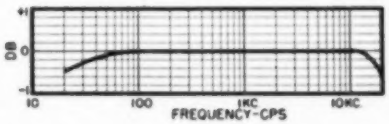


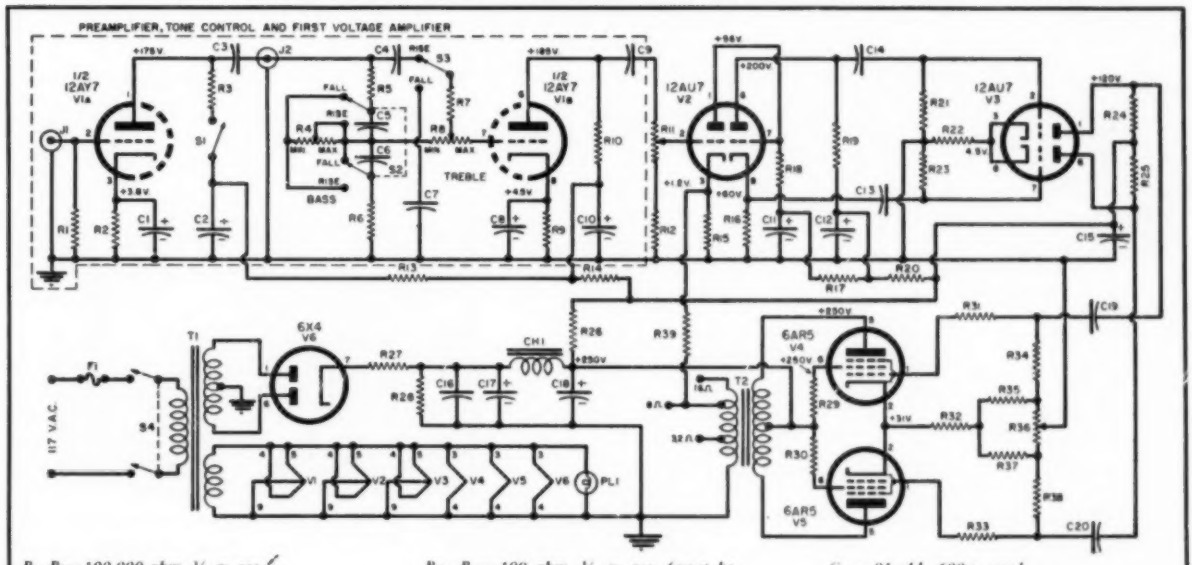
Fig. 4. Over-all response of the amplifier.

The Amplifier

The amplifier built by the author incorporated both a preamplifier and a tone control. The preamp consists of one-half of a 12AY7, V_{1A}, as shown in the complete schematic diagram of Fig. 5. This tube was chosen because of its excellent low noise characteristics. If a 12AY7 should prove too expensive or difficult to obtain a 12AX7 could be sub-

(*Continued on page* 162)

Fig. 5. Schematic of amplifier and power supply. The preamp and tone control circuit is shown in dotted box at upper left.

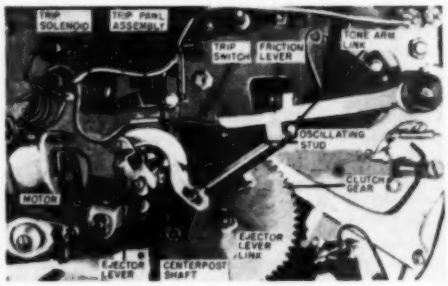
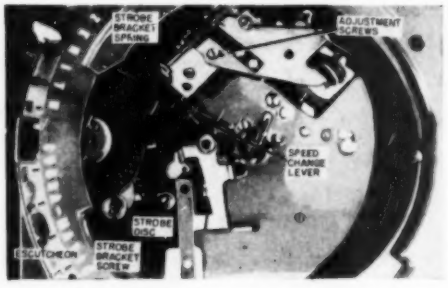


R_1, R_9—100,000 ohm, ½ w. res.
R_2, R_7—2700 ohm, ½ w. res.
R_3—56,000 ohm, ½ w. res.
R_4—250,000 ohm log taper pot
R_5—6800 ohm, ½ w. res.
R_6, R_{13}, R_{15}, R_{16}, R_{17}, R_{20}—10,000 ohm, ½ w. res.
R_8—100,000 ohm linear taper pot
R_{10}—39,000 ohm, ½ w. res.
R_{11}—500,000 ohm log taper pot
R_{12}, R_{22}—560 ohm, ½ w. res.
R_{18}, R_{19}—22,000 ohm, ½ w. res. (must be matched)
R_{21}—47,000 ohm, ½ w. res.
R_{23}, R_{28}—470,000 ohm, ½ w. res. (must be matched)
R_{24}, R_{31}—47,000 ohm, 2 w. res. (must be matched)
R_{25}—2700 ohm, 2 w. res.
R_{27}—39 ohm, 2 w. res.
R_{29}—100,000 ohm, 2 w. res.
R_{30}, R_{34}—100 ohm, ½ w. res. (must be matched)
R_{32}, R_{33}—1000 ohm, ½ w. res. (must be matched)
R_{35}—390 ohm, 2 w. res.
R_{36}, R_{37}—100,000 ohm, ½ w. res. (must be matched)
R_{38}, R_{39}—100 ohm, ½ w. res. (must be matched)
R_{40}—100 ohm linear taper pot
R_{26}—5000 ohm, ½ w. res.
C_1—50 µfd., 25 v. elec. cond.
C_2, C_{10}, C_{11}, C_{12}—10 µfd., 450 v. elec. cond.
C_3, C_9—.1 µfd., 400 v. cond.
C_4—100 µµfd. mica cond.
C_5—.01 µfd., 400 v. cond.
C_6—.05 µfd., 400 v. cond.
C_7—1000 µµfd. mica cond.
C_8*—40 µfd., 25 v. elec. cond.
C_{13}, C_{14}—.1 µfd., 600 v. cond.
C_{15}*, C_{16}*—20 µfd., 450 v. elec. cond.
C_{16}—.01 µfd., 600 v. cond.
C_{17}*—40 µfd., 450 v. elec. cond.
C_{18}, C_{20}—.25 µfd., 400 v. cond.
T_1—Power trans. 260-0-260 v. @ 90 ma.; 6.3 v. @ 3 amps; 5 v. @ 2 amps (not used)
T_2—Output trans. 14,000 ohms push-pull to 500, 200, 16, 8, 3, 1.3 ohms (UTC CG-710)
CH_1—6-15 hy., 200 ohm, 100 ma. filter choke (see text)
J_1, J_2—Phono jack
S_1—S.p.s.t. switch
S_2—D p.d.t. toggle switch
S_3—S.p.d.t. toggle switch
S_4—D.p.s.t. toggle switch
F_1—117 v., 3 amp fuse
V_1—12AY7 tube (see text)
V_2, V_3—12AU7 tube
V_4, V_5—6AR5 tube (see text)
V_6—6X4 tube
*These four cond. mounted in single can

SERVICING RECORD CHANGERS

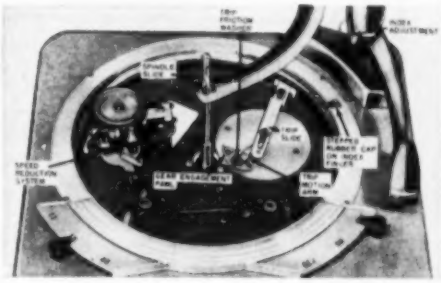
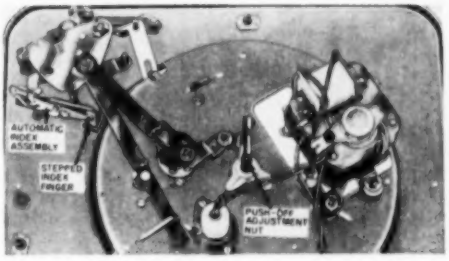
By PERRY SHENEMAN

ZENITH

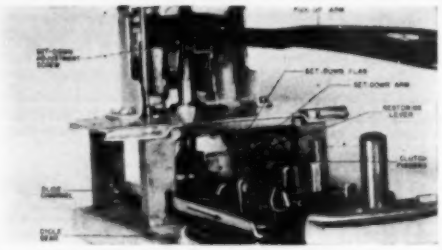
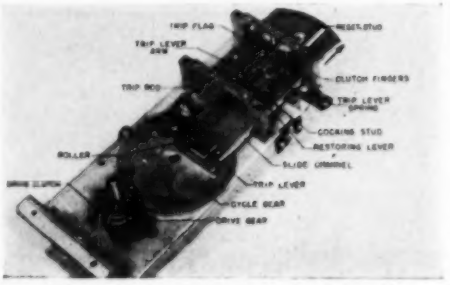
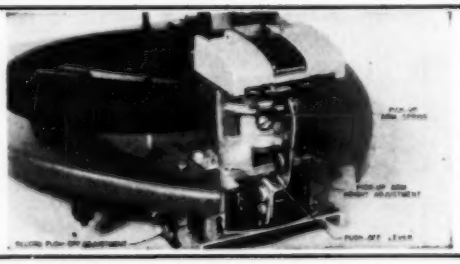
PROBLEM	SERVICE INFORMATION
Changer does not trip into the change cycle.	During normal playing, the friction lever is prevented from contacting the trip switch to complete the solenoid circuit by the oscillating stud. The rapid movement of the tone arm in the trip groove of the record, however, allows the friction lever to contact the trip switch before the oscillating stud can prevent it. The solenoid is then energized and attracts the trip pawl assembly, releasing a segment of the clutch gear to contact the rotating pinion gear under the turntable. If the maximum outward travel of the oscillating stud is more than 1/16" beyond the switch contacts, faulty operation may result. The trip switch support may be bent if necessary to correct this. Check also for dirty silver contacts on the friction lever and trip switch. 
Changer trips too soon.	This may result if the maximum outward travel of the oscillating stud is less than 1/16" beyond the switch contacts.
Changer trips continually or erratically.	The tip of the trip pawl may be too near the edge of the gear segment. Bending the post against which the pawl rests may correct this.
Speed of the strobe does not conform to the speed stop on the escutcheon.	The speed shift lever can be adjusted to indicate the exact speed of the turntable as shown by the strobe by removing the turntable and loosening the two adjustment screws. Set the speed indicator knob to the exact speed and retighten the adjustment screws. 
Records do not drop.	Check for loose set screw holding ejector lever. (See top photo.) The position of the ejector lever and link assembly on the centerpost shaft is critical, if it is incorrect, the ejector cam in the centerpost may break. The ejector lever set screw should be tightened with the ejector cam flush with the center post and the changer in playing position.
Warped strobe disc.	To remove the strobe disc, first slide the selector lever to the extreme right and speed shift lever to far left. Next lift off the turntable and remove the strobe bracket screw and spring. (See bottom photo.) After removal, immerse the strobe disc in hot water for a few minutes to straighten it.
Tone arm removal.	If the tone arm is removed, pay close attention to the position of the spring in the base. If the spring is replaced backwards, the tone arm will not set down on the record.

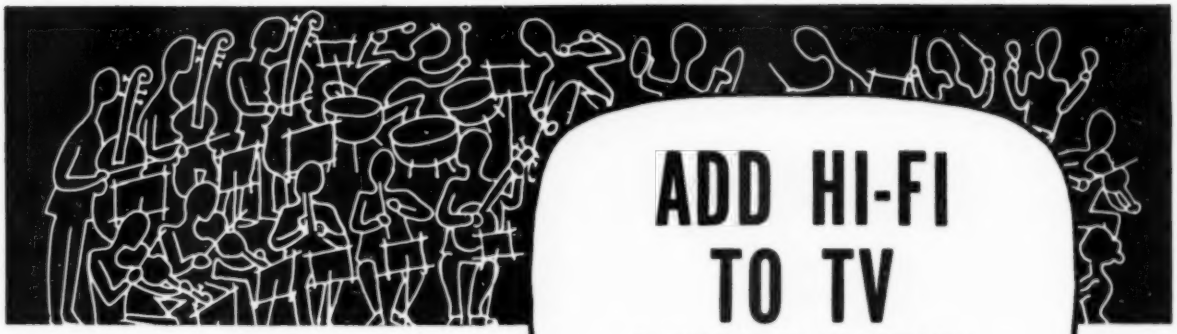
The servicing of automatic record changers requires some mechanical aptitude and a knowledge of the normal sequence of operation of changers. Needless to say, while all automatic changers exhibit some similarities in operation, they are almost all different when it comes to the mechanics by which the various cycles are effected. This article describes the most common faults occurring in three popular changers and the cure for each.

ADMIRAL

PROBLEM	SERVICE INFORMATION
Changer does not trip into change cycle or trips too soon.	The trip slide operates the trip assembly and it must move with the least possible resistance. It must not be bent, rusted, or hindered in its movement. It should be clean and free from grease. The friction washer holding the gear engagement pawl and trip motion arm together must be loose enough to allow the gear engagement pawl to be kicked backward during the playing of the record. It must be tight enough to allow the assembly to follow the quick movement of the trip slide when the tone arm enters the trip groove of the record. If the washer is too loose, there will be no tripping; if it is too tight, there will be constant tripping. The washer may be reshaped to increase or decrease its friction. The stud upon which the friction washer rests may be too loose and may be tightened by inserting an additional washer under the main gear. 
Records do not drop.	Records are dropped by the action of the ejector cam which pushes the bottom record clear of the shelf of the centerpost. The length of travel of the ejector cam can be increased by turning the push-off adjustment nut counterclockwise. Do not increase the length of travel of the ejector cam excessively as this may damage the centerpost and cause jamming during the change cycle. 
Records all drop at once.	The slide in the spindle cap is bent or rusted. (See photo at top of page.) This slide must move freely to hold remaining records while bottom one is being released.
Tone arm does not index correctly for the size record being played.	Set-down position for the tone arm is determined by the automatic index assembly working in conjunction with the index finger. This finger extends momentarily above the changer pan during the change cycle. If it touches a record, the index assembly sets the tone arm for a 12" record; if it does not, and continues upward so that the lower step on the cap touches a record, the tone arm is set for a 10" record. A 7" record permits the index finger to go even higher and this sets the tone arm correctly for this size. If the index finger is bent or loses its rubber cap, the indexing will be incorrect. Burrs in the slots of the index assembly or binding of the pin which rides in these slots cause erratic indexing.
Tone arm does not land in correct indexing groove of record.	Slight adjustments of the tone arm set-down position are performed by means of the adjustment screw shown in top photo.
Slow rpm—wow.	The speed reduction pulleys (see top photo) and the idler wheel must be clean. Check for rust on the shafts. Replace worn or stretched drive belts (turning them inside out will work in an emergency).

MOTOROLA

PROBLEM	SERVICE INFORMATION
Tone arm does not set down in index groove of record.	Turn tone arm set-down adjustment screw on inside of tone arm near the base. 
Erratic set down position.	The set-down flag on the index mechanism (see photo above) is allowing the set-down arm assembly to bounce when in the set-down position. This flag may be positioned so that the hump on the flag will hold the set-down arm securely.
Changer does not trip into change cycle.	The trip flag is not being released by the trip lever arm because the tension spring is loose or missing or the set screws in the trip arm are loose. Perhaps the slide channel is not being pulled back when the trip flag is released. There may be a weak spring or the slide may be binding. It may be that the drive dog adjusting screw in the turntable (see photo below) is not down far enough to contact the drive clutch as the latter falls when the slide channel is released. 
Changer trips too soon.	The wiper on the turntable should slide across the top of the hook on the trip rod. Bend the wiper if it does not make contact. The adjustment should be small.
Changer trips continually.	The drive clutch is probably sitting in slots of drive gear 180° out-of-phase. In order to reposition the clutch, have the changer in playing position and place the drive clutch in slots so that the weighted end rests on the lower half of the incline on the slide channel. (See photo second from top.) Perhaps the index mechanism with the small set-down flag is not being returned to its proper position. To correct this, turn the reject knob and rotate the turntable until the slide channel moves backwards, raising the tone arm. Pull the index assembly down.
Erratic tripping.	The turntable washer sitting in the drive gear may be missing. This causes vibration and makes the drive clutch crawl up the trip lever incline on the slide channel, lodging against the stop at the end. This may cause enough binding between the drive clutch and the slide channel to prevent the latter from being drawn backward.
Records do not drop.	To drop the records correctly, the push-off lever must extend at least $\frac{1}{32}$" beyond the record support shelf during the record dropping portion of the cycle. The push-off adjustment determines this distance. 
Slow rpm or thumping. Insufficient power to rotate the turntable through the change cycle.	Cleanliness is the most important single factor in the motor and speed reduction system. Clean with carbon "tet" and rough the pulleys and idler wheel slightly with sandpaper to remove gloss. Worn pulleys cause wow and thumping. Rust on the pulley shafts will reduce the rpm.



ADD HI-FI TO TV

By **WALTER H. BUCHSBAUM**
Television Consultant
RADIO & TELEVISION NEWS

Improve the quality of the audio from your TV set by adding a hi-fi amplifier—but, follow these hints.

MANY of the hi-fi enthusiasts who occasionally deign to watch television complain bitterly about the TV sound quality and various attempts are made to improve the audio coming from the TV set. This can be done by either modifying the existing circuits or by feeding the audio to a separate hi-fi amplifier. Often it appears that even the use of a good separate amplifier does not do much for the sound quality and this is quite vexing because the TV sound is carried by FM and has theoretically a response over 10 kc.

This article deals with the problems encountered in connecting a good audio amplifier to a TV receiver. Some of the inherent limitations of TV sound fidelity are discussed, best points for tapping into the audio section of TV receivers are covered, and some of the pitfalls common to this work are pointed out.

Irrespective of the bandwidth and audio frequency response of the associated networks, most TV sets are limited in audio reproduction by the presence of the video signals. The vertical sweep frequency is 60 cps and the horizontal scanning rate is 15,750 cps. At both these frequencies there are strong a.c. fields at the TV chassis, as well as pulses on the video carrier and high voltages at the picture tube neck. When an audio amplifier is used with real sensitivity at 60 cps and above 15 kc., the interference from these two signals will be audible. It is therefore futile to try for audio responses down to 60 cps or up to 15 kc.

There are three general classes of FM detector circuits in use in TV sets, as illustrated in Figs. 1, 2, and 3. The discriminator and ratio detector generally feed their outputs into an audio voltage amplifier which then drives the output tube. This means that the levels of audio available at the FM detector for the circuits of Figs. 1 and 2 are on the order of 0.01 volt. The volume control is generally located at the detector output and it might appear as a convenient point to take the sound off for the hi-fi amplifier. As explained later, this is not really the best tap-off point at all.

In Fig. 3, the 6BN6 gated-beam detector combines the functions of the FM detector and voltage amplifier in a single stage. While the output of this stage is not sufficient to drive an output amplifier like the 6K6, it is on the order of 0.5 volt and sufficient for a high gain tube such as the 6BK5 or 6AC7. When tapping off the audio from a TV set using a 6BN6 it is well to remember that considerably more amplitude is available than from other types of FM detectors.

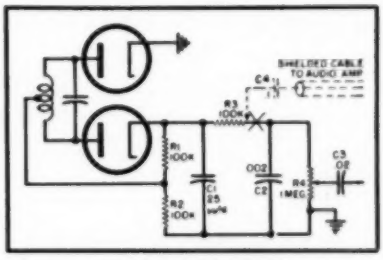


Fig. 1. Typical FM discriminator circuit used in early TV sets. The "X" marks the take-off point to feed to an amplifier.

Frequency Response of Tap-off

In most TV receivers the audio frequency response is not an important factor and when small speakers and simple amplifier circuits are used, no real attempt is made to preserve either the high- or low-frequency end. This is evident from Figs. 1, 2, and 3 when looking at the volume control and coupling condenser leading from it to the following audio stage. A .02 μfd. condenser has a reactance of 100,000 ohms at 75 cps, hardly the right value for a coupling condenser for low-frequency audio.

On the high-frequency end, the de-emphasis network used in most TV FM detectors will wreck the response. The network of R_3 and C_3 in Fig. 1, for example, was originally designed to reduce the high frequency response of the discriminator to compensate for the over emphasis of the highs at the transmitter to allow for some transmission characteristics. In most sets, however, this filter has a much lower cut-off frequency than originally intended. It helps avoid audio regeneration in the receiver, limits the audio response, and makes for some accentuation on the low frequencies, giving an apparently better sound.

The .002 μfd. condenser, C_3, in Fig. 1, has an impedance of only 8000 ohms at 10 kc., which means that in the circuit of Fig. 1 a 10 kc. audio signal will be attentuated more than 20 db. It now becomes apparent why we do not advocate tapping into the TV receiver right at the volume control. The best tap-off point is just before the bypass condenser at the volume control and this point is shown at "X" in Figs. 1, 2, and 3. It is suggested that a large coupling condenser, at least .1 μfd., be used in series with the cable and that the de-emphasis filter condenser and the volume control be disconnected where possible.

In the circuit of Fig. 2, it is necessary to add a 1 megohm resistor, R_1, to ground to provide a path for d.c. In the gated-beam detector of Fig. 3, the volume control is at the same time the plate load resistor and must remain in the circuit. The .02 μfd. coupling condenser C_3, however, should be disconnected. To improve

(*Continued on page 84*)

Fig. 2. Ratio detector circuit found in many TV sets. Note that it is necessary to add a resistor from the audio take-off point to ground in addition to the coupling condenser to the hi-fi audio amplifier.

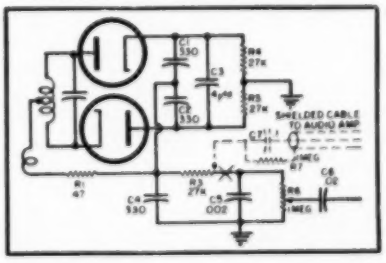


Fig. 1. Front panel view of the power supply unit. An optional meter for reading current can be added.

A TRANSISTOR POWER SUPPLY

By **LOUIS E. GARNER, JR.**

Construction details on a unit whose low and high positions provide d.c. output voltages from 0 to 8 or 0 to 100 volts.

ONE of the basic needs of a worker in almost any branch of the electronics field where development work is undertaken is an adequate experimental power supply. While batteries will often suffice for a while, the average experimenter and engineer soon tires of the nuisance of having an assortment of batteries cluttering up the work bench, and of finding that a battery is "dead" in the middle of an experimental project. It isn't too long before the worker starts thinking in terms of an a.c.-operated voltage source.

The author, conducting a series of experiments with transistor circuits, soon found that batteries were far from satisfactory as a power source for development work — even where the circuits being designed were to eventually be used in battery-operated equipment.

Conventional d.c. power supplies, as used in tube circuit design work, were also found to be inadequate for transistor circuitry because of the low voltages required. While tubes may require from 100 to 450 volts d.c., few transistors require more than 70 volts, and many types have a *maximum* voltage rating under 50 volts; the types CK722 and CK721, for example, have a maximum rating of only 20 volts!

Although it is possible to obtain such low voltages from a 300 volt source by using dropping resistors or voltage dividers, the results obtained are not too satisfactory. Since bypass or filter condensers must be used to prevent the series resistors from affecting the operation of the experimental circuit, it isn't too long before the workbench becomes cluttered with power resistors, electrolytics, and a nest of wire leads.

Therefore, the obvious solution was followed and an experimental power supply was designed and built specifically for transistor circuit development work and "breadboard designing." Interior and exterior views of the completed unit are given in Figs. 1 and 3, while the schematic diagram is given in Fig. 2.

Design Problems

From a theoretical viewpoint, the "ideal" power source for a transistor circuit would be a "constant current" supply (in the same way that a constant voltage supply is considered "ideal" for tube circuits). However, it is considerably more difficult in practice to achieve a true constant-current supply than it is to build a constant-voltage supply circuit.

Even if a true constant-current supply were built and used in experimental design work, it would not necessarily follow that circuits designed and tested with such a power source would operate satisfactorily in practical equipment where a constant-current source could not be used.

With these points in mind, it was decided to design and build a conventional power supply but with a few important modifications. These modifications are apparent in the schematic diagram given in Fig. 2.

Circuit Description

A transformer having a 117 volt and a 6.3 volt secondary (T_2) is used to supply voltage to a half-wave selenium rectifier $Rect._1$, with a selector switch provided to select which of the secondary windings is employed (S_3).

Selector switch S_3 also selects the proper multiplying resistor (R_2 or R_1) to use with the 0-1 ma. meter M_1 so that a voltmeter having a full-scale reading of either 10 volts or 100 volts is formed. The meter is connected across the output terminals of the supply and thus permits determining, at all times, exactly how much voltage is applied to the circuits being tested.

The filter circuit employed is conventional, consisting of a "pi" type filter made up of CH_1, C_1, and C_2. R_3 is used to prevent current surges as C_1 charges (which might damage the selenium rectifier).

In order to provide a continuously variable output voltage, the primary of T_2 is supplied with a.c. voltage from an adjustable autotransformer, T_1. This transformer provides a.c. voltages from 0 to 135 volts.

With this arrangement, the d.c. output voltage obtained is adjustable from 0 to about 8 volts with S_2 in the "Lo" position, and from 0 to over 100 volts with S_2 in the "Hi" position.

Since the autotransformer used (T_1), a *"Powerstat"* Type 20, can supply currents up to three amperes, considerably more than is required by the d.c. supply, a standard receptacle, SO_1 was placed on the back of the chassis to provide a.c. voltages from 0 to 135 volts. Switch S_3 is provided to cut off the d.c. power supply when the unit is used only as a variable a.c. voltage source, and thus obtaining the full power output of the autotransformer. A 3-ampere fuse is provided to protect the brush in the center arm of the autotransformer from damaging overloads.

Switch S_3 is of the "lock-in" push-button type and is mounted on the rear of the chassis, along with receptacle SO_1.

If the reader wishes to duplicate the unit described, but does not care for the variable a.c. voltage feature, receptacle SO_1 and switch S_3 might well be omitted. In such a case a smaller *"Powerstat"* (Type 10) might be employed, at an appreciable financial savings.

However, the author has found that the variable a.c. voltage feature is well worth the added expense and space requirements of the larger *"Powerstat."*

Since a 3-ampere current rating is ample to handle many types of electronic equipment, even including the

majority of TV receivers, this feature permits the user to check the operation of a.c. (line) operated equipment under conditions of "high" and "low" line voltage.

The remainder of the circuit is conventional, consisting of an "on-off" power switch, S_1, and a neon pilot light, PL_1, with its dropping resistor R_1.

Construction Hints

Construction and wiring of the transistor power supply are conventional and straightforward and no special precautions need be taken. It is suggested, however, that both the negative (minus) and positive (plus) output terminals be allowed to "float" above chassis ground.

Reasonable care should be exercised when working with the more expensive components, the meter and the "*Powerstat.*" No attempt should be made to mount either of these components until all chassis and front panel drilling and punching have been completed. Excessive vibration could damage the meter movement, and a slip of a drill or other tool could easily damage the exposed windings of the "*Powerstat.*"

Considerable modification of the basic circuit is possible to meet the specialized needs of different experimenters. For example, the possibility of omitting the variable a.c. output feature and using a smaller autotransformer has already been mentioned. Other modifications follow:

Should the prospective builder prefer a vacuum-tube rectifier to a selenium rectifier, such may be used. A separate filament transformer should be provided and connected *directly across the line terminals* on the instrument side of the power switch. Do not connect the filament transformer primary in parallel with the primary winding of T_2—with such a connection, the filament voltage will vary as the output voltage is adjusted.

The author would have preferred to use a transformer having a 117 volt and a 12.6 volt secondary in place of T_2, but was unable to obtain such a transformer locally. If the builder has such a transformer available, it is suggested that he use it in place of the one specified in the parts list.

A meter having a full scale reading of 1.5 ma. might well be substituted for the 0-1 ma. meter used by the author, thus providing full-scale readings of 15 and 150 volts. A number of these meters were available on the surplus market and the reader may be able to find one at low cost.

Still another modification is to provide an additional rectifier and filter circuit so that both "Hi" and "Lo" d.c. output voltages are available simultaneously (S_3 would then be used only in the meter circuit). This arrangement might be found preferable by the individual builder for some applications. The "minus" (or "plus") binding post could be made common to both outputs, or two complete sets of output terminals could be provided.

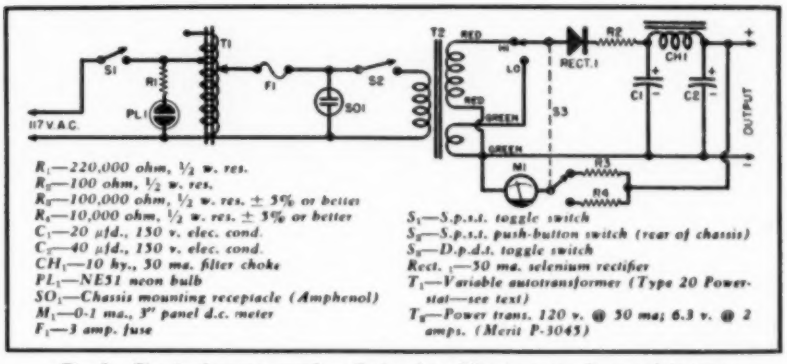


Fig. 2. Circuit of power supply. Optional modifications are discussed in text.

Another modification, useful for some applications, is to provide a separate current meter on the front panel of the instrument so that both "output voltage" and "circuit current" may be read simultaneously. If preferred, however, the basic meter movement used as a voltmeter may be employed in this application, with a special selector switch (and appropriate shunts) provided.

Where the builder plans to retain the variable a.c. voltage feature, he might prefer to bring the output receptacle (or terminals) to the front panel and even to provide an a.c. voltmeter so that the actual output voltage may be checked at all times. An alternative would be to provide an instrument rectifier to convert the basic meter movement to an a.c. voltmeter, with an appropriate switching arrangement (so that the 0-1 ma. meter may be used as either an a.c. or d.c. voltmeter, or as a current meter).

There is one other modification that may be preferred by some builders. Where the intended use of the power supply will not require more than 25 volts for any application, where all work is with junction type transistors exclusively, for example, an entirely different type of transformer may be substituted for T_2. A 25.2 volt transformer, such as the *Stancor* type P-6469, may be used, so that a variable output from 0-25 volts is obtained.

A bridge-type selenium rectifier may be substituted for the half-wave rectifier specified in the parts list.

Where a single, rather than a dual, ouput voltage range is provided, switch S_3 may be omitted. In addition, only one meter multiplier resistor need be provided (25,000 ohms with a 25 volt transformer).

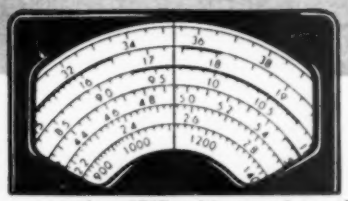
Operation and Applications

The transistor power supply described is used like any other experimental power supply with but two important differences in operation. First, since a vacuum-tube rectifier is not used (in the model shown), no warm-up time is required. The instrument is simply turned "on" and is im-

(*Continued on page* 181)

Fig. 3. Rear view of power supply. If to be employed exclusively for low voltage applications, for example, transistors, a smaller autotransformer can be used.

International SHORT-WAVE



Compiled by KENNETH R. BOORD

THERE are quite a few interesting items about club doings this month as the winter DX season goes into high gear.

Austria—Heinrich Philipp, president, Austrian DX-Club, Landgutgasse 41/19, Vienna 10, Austria, says response to an item in the August issue of this magazine has been great and the club now has 134 Austrian and 90 foreign members (latter are mostly from USA). The club now issues a regularly monthly bulletin in *English;* one in German may be added later. Membership is free but an IRC should accompany a request for membership. Plans to issue a "diploma for best DX members" soon.

USA—Southwestern Short Wave Club, Dallas, Texas, now has six regular members. The group uses a *Hallicrafters* S40-B receiver with a horizontal antenna 40 feet in height oriented northwest by southwest. Mike Boone is president of the organization.

The New England Listeners Club has started a card-swappers' exchange for the benefit of SWL's who wish to exchange their cards with others in the USA and abroad. Anyone who wishes to do so can send seven of his SWL cards along with a stamped, self-addressed envelope and five cents in stamps to cover postage—to the NELC, SWL Exchange, 7 Harding St., Fitchburg, Mass. In exchange, the NELC will try to send the SWL cards from States and countries that the SWL needs cards from. (Rivers, Mass.)

Johnny Alley, Middleboro, Mass., is a SWL who tunes mostly the ham bands, both c.w. and phone. He uses a 35-foot vertical antenna and a 200-foot half-wave which runs east-south. Johnny, who is chief operator of a Citizens station, was a radio operator in both the Navy and Marine Corps. He is an associate member of the ARRL and a member of the ISWL, an English club.

Around the World

(*Note:* Between the time this was compiled and the release of this issue, some stations will have changed to *winter* schedules in which cases you may find broadcasts *one hour later* than listed herein.—K. R. B.)

Afghanistan—Kabul Radio, 9.975, is heard in Sweden 1215-1240 with news, music. (*Nattugglan,* Sweden)

Alaska — ALB, 9.200A, Anchorage, noted *testing* 1100, fair level with bad QRN. (McDaniel, Idaho) ALE, 5.900A, Ketchikan, noted 0005 with poor modulation and slight QRN. (Kippel, Colo.)

Albania—Occasionally, *Radio Tirana,* 7.852A, can be heard 1700 with *English* to 1730A closedown. (Cox, Dela.; Sutton, Ohio) Noted with *English* 1400, fair level, CWQRM. (Hardwick, N. Z.)

Algeria—Radio Algerie, 6.160, noted in heavy QRM 1645-1730A closedown. (Hill, N. H.)

Andorra — Radio Andorra, 5.990A, noted at good level 1645 with music. (Hill, N. H.) *Measured* 5.985 recently 1739. (Ferguson, N. C.)

Anglo-Egyptian Sudan — Radio Omdurman, 6.410, noted in Arabic 1145, fair; heard on 7.100 at 1230, weak and with CWQRM. (Hardwick, N. Z.) Heard in Britain on 4.995A to 1430 closedown. (ISWL, England)

Angola — CR6RA, 11.862A, Luanda, heard at fair volume 1545 in Portuguese; has gong 1600, then music. (Cox, Dela.)

Argentina — Buenos Aires, 15.345, good level 1145, announcing for LRA. (Niblack, Ind.) LRS, 11.880, is good level in Portugal around 1800. (de Mesquita e Sousa)

Australia—VLC9, 9.615, is excellent 0700-0845 to Eastern North America. (Peterson, Texas; Koch, Ore.) VLM4, 4.920, noted 1030-1100 at good level in Calif. (Cook) VLB9, 9.580, noted 0120-0230, strong in N. C. (Jones) Heard on 15.200 around 1600. (Buehler, Ohio) VLI6, 6.090, Sydney, N.S.W., is heard *past* 0700. (Butcher, Mass.)

Austria — Blue Danube Network, 9.617, Salzburg, noted with news 0405. (Pearce, England)

Azores—Ponta Delgada, 4.865, heard opening 1515 with marches. (Pearce, England)

Belgium—ORU, Brussels, now uses 9.767, *replacing* 11.850, to North America 1900-2200 (*English* from 2000), with relay still over OTC2, 9.655, Leopoldville, Belgian Congo. (Foster, Ill., others)

Belgian Congo—OTC2, 9.655, is excellent in relay of ORU, Brussels, to North America 1900-2200. (Rambo, Md.; Pepper, N. C., others)

Bolivia—CP38, La Paz, *lists* frequency now as 9.440; however, was *measured* on 9.442; closes 2130A. Officials say plans to relocate in about a year. (Ferguson, N. C.)

Brazil—ZYB7, 6.095, *Radio Difusora Sao Paulo,* heard in Portuguese 2100, closing 2200, fair level with some sideband QRM. (Hardwick, N. Z.) ZYE7, 4.825, *Radio Ecuadora de Parnaiba,* noted 1730 with "A Voz de Brasil" relay; CWQRM. (de Mesquita e Sousa, Portugal)

British Borneo — The Broadcasting House of *Radio Sarawak* is a beautiful white building situated on a hilly place in Kuching, on a site in "Rock Rock," opposite the Sarawak Museum grounds; the people of Sarawak are very proud of this, their new building, because it is the first Broadcasting House erected by the Government for its people. At present, *Radio Sarawak* broadcasts on 4.860A with 5 kw. at 0530-0830A. (*Malmo DX-aren,* Sweden)

British Guiana—ZFY, *Radio Demerara,* Georgetown, seems as low as 3.250 lately; has fairly good signal when closing 2115-2120A. (Cox, Dela.) The 5.918 outlet, 2 kw., is scheduled 0445-1445, while 3.255, 2 kw., is listed 1445-2115. (*WRH*)

British Honduras—ZIK2, 3.300, *Radio Belize,* noted closing 2246A. (Hannon, Mich.; Peterson, Texas, others)

Bulgaria—Radio Sofia, 9.700, noted with *English* to North America 2000-2030; announces *English* for Europe on 7.670, 7.255A at 1500-1530, 1630-1645, 1715-1730. (Salovey, N. Y.; Jacobson, Ill.) Is good on 9.700 in *English* to North America 2300-2330. (Pepper, N. C., others)

Canada — VE9AI, 9.540, Edmonton, Alta., logged 2200 with news; weak level, heavy QRM. (Hannon, Mich.; De Mann, Minn.) Heard with news 0900. (Koch, Ore.) CBUX, 6.160, Vancouver, Brt. Columbia, heard 1030-1100. (Cook, Calif.) CBNX, 5.970, St. John's, Newfoundland, noted 2100 in heavy QRM

(*Continued on page* 147)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock, has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

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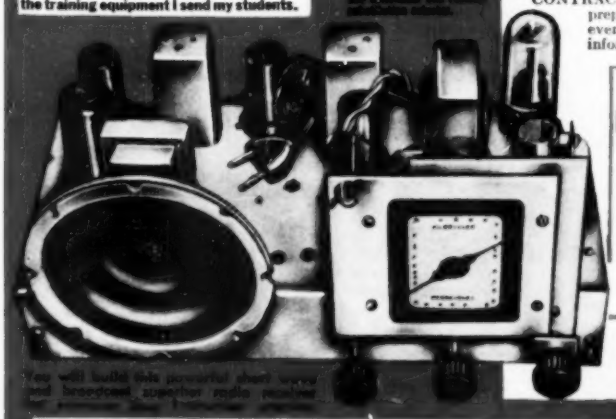

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THE MODEL FM-80 TUNER

Front panel view of the new Fisher Model FM-80 tuner.

Two meters, one to indicate signal strength and the other showing tuning accuracy, are features of this unique unit.

AN FM tuner which is equipped with two meters, one to indicate signal strength and the other to indicate the exact center-of-channel for micro-accurate tuning, is the latest offering in the *Fisher Radio Corporation* line.

The Model FM-80 tuner's signal strength meter can also be used for orientation of the antenna to achieve optimum performance.

Mounted on the front panel are not only the station selector and a.f.c. controls but also a variable sensitivity control. This latter permits exact adjustment of sensitivity to the requirements of the location, based on the prevailing signal strength.

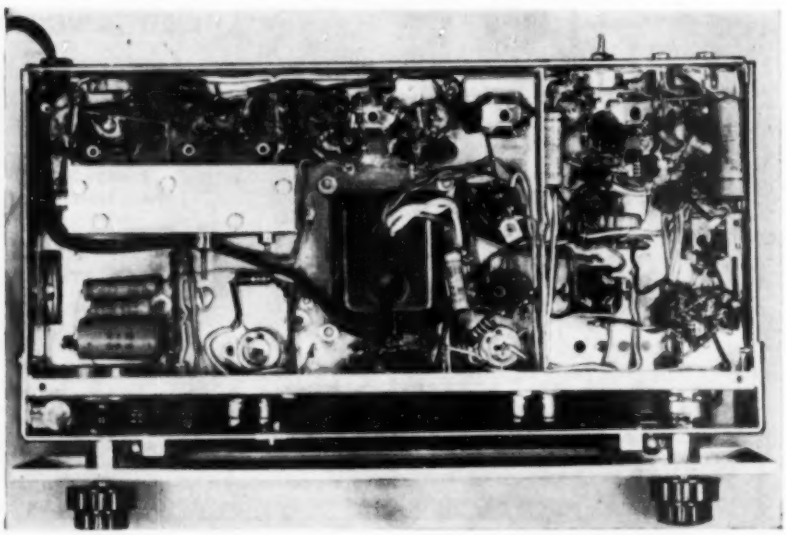
The tuner uses the *Armstrong* system with two i.f. stages, dual limiters, and a cascode r.f. stage. Full limiting is obtained even on signals as weak as 1 microvolt. There are dual antenna inputs, one for 72 ohms and one for 300 ohms balanced.

Sensitivity is 1½ microvolts for 20 db of quieting on the 72-ohm antenna input and 3 microvolts for 20 db of quieting on the 300-ohm antenna input. The chassis is completely shielded and shock-mounted with full shielding of the tuning condenser to eliminate microphonics and noise from accumulated dust. The double-shielded r.f. section reduces oscillator radiation and provides maximum r.f. performance.

The tuner has two bridged outputs, a low-impedance and a cathode-follower type, permitting output leads up to 200 feet.

The set uses 11 tubes. It is self-powered and the entire unit is housed in a 12¾" x 4" x 8⅛" chassis which weighs 15 pounds. —30—

Underchassis view of tuner showing the shielding and component parts layout.



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MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE

DISCOUNT HOUSES

OUTRIDERS of approaching winter could be seen on every hand. Bloated dark gray clouds rolled endlessly overhead; the northwest wind had a sharper bite to it; and the oil furnace in Mac's Radio Service Shop, nudged by the chilling thermostat, had awakened from its summer hibernation and quietly taken over its task of keeping the rooms warm and cosy.

Mac and his helper, Barney, had plenty to do, but by mutual consent they were taking a short break. Mac was perched on a high stool tilted precariously back against the wall, and Barney sat dangling his long legs over the edge of the radio service bench.

"Hey, Mac," the youth said suddenly, "Last night I got over to Margie's early for our date, and I had to wait while she put on her face. This takes no little while, considering what a nice face she has to start with; so I spent the time threshing through the magazine rack. Her old man is an appliance salesman, and the magazines were mostly those published for appliance dealers. I couldn't help noticing that several editorials and articles in them were devoted to what was termed 'the serious problem of discount houses.' Seems these are stores that sell nationally advertised refrigerators, dryers, washing machines, ironers, toasters, radios, TV sets, and cameras at a considerable discount below list price to the general buying public.

"A typical store of this kind cuts overhead to a minimum by doing away with all plush store furnishings, employing only a few 'order takers' instead of several trained clerks, and omitting all service and store guarantees. The customer walks into one of these stores, picks out what he wants from factory-sealed cartons sitting on bare tables, pays the price asked—which is usually twenty to thirty per-cent below list—and walks out. His purchase is then his baby. The only guarantee he has is that provided by the manufacturer, and if anything goes wrong, he can either have it repaired at his own expense or return it to the factory for a possible adjustment. In spite of this, the inducement of the lower prices draws enough customers to worry the heck out of regular dealers."

"I mentioned this to Margie's pop, and that was a mistake. He immediately got all steamed up and started explaining to me what an evil thing discount houses were. By the time I finally pried myself loose from him, we were ten minutes late for the beginning of the feature picture."

"I know what you are talking about," Mac drawled. "*Life* ran a story on the subject two or three months back. They mentioned this discounting was rearing its ugly head even in automobile selling. All the time I was reading the article, though, I kept thinking that if misery really did love company, this development ought to make the service fraternity feel real good."

"How's that?"

"Simply because we have been living with this 'new' problem for several years. In practically every large city there is a radio parts house that will sell at wholesale prices to anyone who walks through the doors or who will send in a two-cent postcard for a catalogue. In other words, any one of our customers can buy condensers, tubes, resistors, TV antennas, and so on, from one of these places for the same price we have to pay our distributor. Now and then this leads to some amusing experiences. For example a customer will slyly intimate he is 'on to' our little game; then he will triumphantly whip out one of these wholesale catalogues and point out where he could have bought the tube for which we charged him two dollars for only a dollar-twenty—plus postage, of course."

"What do you do then?"

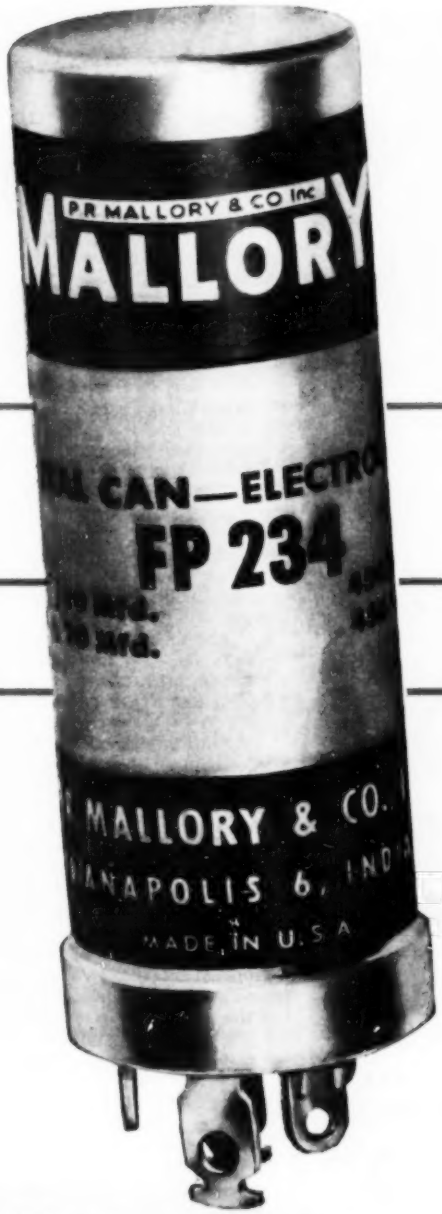
"Express surprise that he could be so naive as to think we should sell parts for the same price we pay. I ask him if he knows of any other store that does this—and stays in business. As gently as possible, I disabuse his mind of the mistaken idea that the difference between list and net prices on the parts we install constitutes 'something extra' added on to a legitimate charge for a service job. I explain that service charges are not just numbers plucked out of thin air but are realistically geared to hard facts and figures in the service business. The gross profit in those charges must do three things: (1) cover all overhead expenses such as rent, light, telephone, fuel, truck expenses, insurance, advertising, depreciation, wages for you and Miss Perkins, and so on; (2) provide a reasonable return on the capital I have invested in instruments, furnishings, truck, service library, and parts stock; and (3) give me a fair salary for doing service work and operating the business.

"Money to do these things comes from just two sources: first, there is the actual service charge for doing the work; second, there is the difference between the list price we charge for the parts we put in and what these parts cost us. Income from *both* sources is anticipated in drawing up our scale of service charges. If income from one source disappears, the income from the other source must be boosted to take care of the lost revenue; otherwise, we should soon find that we were not making money at all but were just handling it.

"We do everything we can to buy parts as cheaply as we can without making any sacrifice in quality. Quite often we buy in quantity to get a better discount. Sometimes one distributor will offer a better discount in an effort to get new customers. Whatever saving we accomplish through wise buying is actually passed on to the customer in the long run through the reduction we are thus able to make in our service charges. It does not take any great intelligence to see that if we did not make a profit on the parts we should have to raise those service charges considerably to achieve the same net income from the same amount of time and effort expended."

"You mean that if a guy brought in some filter condensers and wanted

(*Continued on page* 86)



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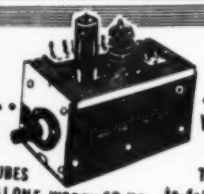

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NEW MIXER—FADER

Details on a new audio component which is designed for professional use as well as home applications.

OF INTEREST to all who use recorders, whether tape, wire, or disc, is the new mixer-fader unit being offered by *Fisher Radio Corporation* as its Model 50-M.

The new unit offers facilities of professional quality for the blending of two signal sources of equal or different strengths. The action of the two continuously variable channel controls makes it possible to use the unit for fading smoothly from one channel to the other without any switching noise or interruption of either signal.

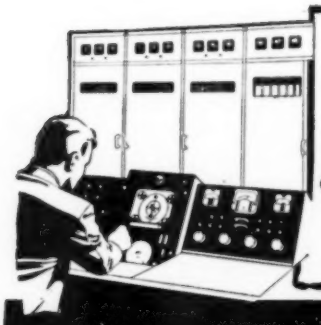
The Model 50-M is all-electronic and thus avoids the inherent limitations of the non-electronic, passive-resistive mixer. There is no insertion loss and hence there is no impairment of the signal-to-noise-to-hum ratio of the audio output.

The unit has two high-impedance inputs; a low impedance, cathode-follower output which can be used with lead lengths up to 200 feet; additional 10 db amplification available by shorting out one resistor; low distortion and low hum level; self-powered; and a strong, attractive housing.

The Model 50-M can be used with any combination of radio-phonograph, phonograph, preamplifier, equalizer, recorder, p.a. system, and TV receiver. It can be used in broadcast stations and professional recording studios as well as in home applications.

The unit may be used as a fader by operating the two channel levers simultaneously. The normal action of the levers is in opposition so by depressing both simultaneously, the signal of channel 2 will fade gradually and uniformly, while channel 1 will increase to maximum. —30—

Over-all view of Model 50-M mixer-fader. It can be removed from case if desired.



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Elmer Powell, Box 274, Sparta, Tenn.

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Letter from nationally known manufacturer of high quality AM and FM transmitters, "We are very much in need at the present time of radio-electronics technicians and would appreciate any helpful suggestions that you may be able to offer. Salary up to $412 per month to start."

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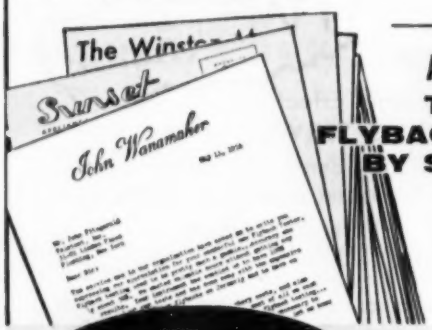

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A New Magazine on Practical Electronics for the Hobbyist, the Experimenter and the Novice

Add Hi-Fi to TV

(*Continued from page* 73)

high-frequency response, C_2 should be removed and C_3, 220 $\mu\mu$fd., substituted.

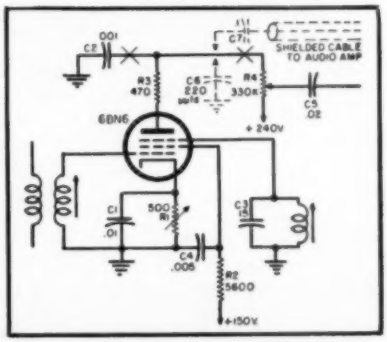
Hot Chassis

Many of the inexpensive TV receivers now on the market use a "hot" chassis, meaning that one side of the a.c. line is connected to the chassis. It not practical to simply connect the separate audio amplifier to the regular TV chassis ground in these receivers. To overcome this difficulty, the simplest solution is a power line isolation transformer for the TV set, thus making the chassis no longer "hot" and simple chassis-to-chassis connections can then be made.

Another solution is to use an audio transformer between the TV set and the hi-fi amplifier. The drawback of this scheme is that a good impedance match as well as satisfactory frequency response is required from the transformer and this means a fairly expensive unit. If the hi-fi amplifier tone controls have sufficient range to compensate for some loss at the high and low end, a regular interstage audio transformer can be used. The plate winding is connected between the tap-off point and ground, through the coupling condenser, to avoid loading the d.c. circuit. The grid winding can then be wired between the amplifier input and ground without danger of shorting the a.c. line. In this arrangement it is safest to locate the audio transformer at the TV set and avoid running "hot" wires outside the cabinet. The latter hook-up can cause a.c. hum in the sound, the remedy for which is usually a simple reversing of the plug of either the TV set or the amplifier.

From the foregoing it should be apparent that feeding the TV sound to a hi-fi amplifier is not a difficult job once the right connections are known. —30—

Fig. 3. Partial schematic of the gated-beam FM detector used in many TV sets today. Two condensers must be added to this circuit, as shown below, and condenser C_2 must be removed when feeding to an external high-fidelity audio amplifier.

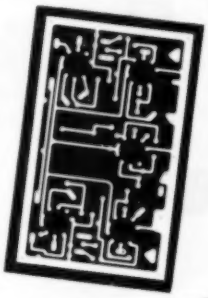


NEW 1955

Heathkit Engineering Features

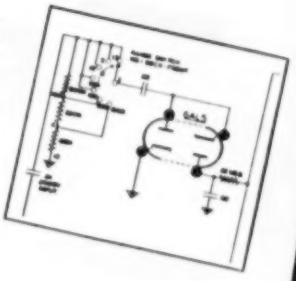
New PRINTED CIRCUITS

One of the many tremendous improvements in the new 1955 Heathkits is the use of an etched metal process printed circuit board. Printed circuits will be used in Heathkits whenever they will affect construction simplification, performance stabilization, and lend themselves to instrument design. Now for the *first* time a kit instrument company offers the advantages of modern printed circuit instrument construction technique. For the *first* time consideration has been given toward reducing kit assembly time. Also this is the *first* time that printed circuit boards have been hand soldered on a volume basis. Offered only by Heathkit, the pioneer and leader in kit instrument design.



New PEAK-TO-PEAK VTVM CIRCUIT

New 6AL5 full wave rectifier in AC input circuit permits full scale peak-to-peak measurements. Seven ranges — upper limits 4000 volts peak-to-peak. Just the thing you TV servicemen have needed in making TV circuit voltage checks. Precision resistor voltage divider limits AC RMS level to 150 volts. Prevents overloading the rectifier—extends upper limit AC RMS ranges to 1500 volts—further protects meter and circuitry against AC flash-over or arcing. Another definite example of continuing Heathkit design leadership in the kit instrument field.

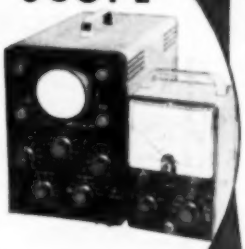


New HIGH READABILITY PANELS

New 1955 Heathkits feature complete panel redesign. Sharp white lettering applied to the beautiful charcoal gray panels, provide a new high in readability. Lettering is easy-to-read open style and panel calibrations are vividly clear against the pleasing soft gray background. New knobs of exclusive Heathkit design.

New 3" UTILITY SCOPE

The new 3" Scope is a "natural" for the well rounded line of Heathkit instruments. Small in size, 11¾" deep, 6½" wide, 9½" high, yet big in performance. Just think of the value an Oscilloscope for $29.50. Brilliant intensity, sharp focusing, wide positioning range. An ideal portable Scope for the TV serviceman—a second shop scope—modulation monitor for you hams (deflection plate terminals in rear of cabinet). Performance to spare for all general scope applications. See specifications on following page.

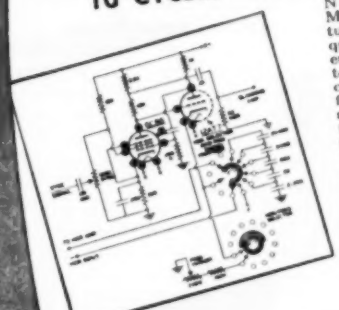


New STYLING *New* COLOR

New styling and coloring is responsible for tremendous improvement in Heathkit appearance. The new instrument panel color combination is high definition white lettering in a soft charcoal gray panel. Cabinet color is a lighter feather gray. The satin gold baked enamel cabinet for the WA-P2 Preamplifier is further indicative of the modern pacesetting trend in Heathkit styling.

New SCOPE SWEEP CIRCUIT 10 CYCLES — 500 KC

New 1955 Heathkit Model O-10 Scope features a new wide frequency range sweep generator covering 10 cycles to 500,000 cycles. This coverage is available in five virtually decading sweep ranges and is five times greater than the sweep frequency range usually available. Excellent retrace time characteristics, actually less than 20% at 500 KC. Use of the free running Heath circuit provides a larger margin of stability and a new high in Heathkit Scope performance.



Continuing PROGRESS FUTURE LINE EXPANSION

The outstanding improvements featured in the 1955 Heathkit line are representative of the progress characterized by Heath Company operation. Long range planning will provide a continuing succession of new kit releases to further expand the Heathkit line which already represents the world's greatest selection of electronic kits. The innovations in the 1955 line, are representative of additional new models scheduled for release for the coming years.

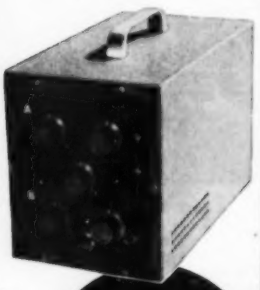
SEE THE INSTRUMENTS ON THE FOLLOWING PAGES

HEATH COMPANY • • Benton Harbor 15, Mich.

Heathkit ELECTRONIC SWITCH KIT

Tube complement: 2—6SL7, 2—6SN7.

Continuously variable switching rates in three ranges from less than 10 CPS to over 2000 CPS.



Individual input gain controls, position control, coarse frequency control, and fine frequency control.

Transformer operated for safety when used in conjunction with other equipment.

MODEL S-2

$23.50

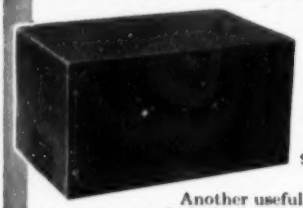
Shpg. Wt. 8 lbs.

The basic function of the Heathkit Electronic Switch Kit is to permit simultaneous oscilloscope observation of two separate traces which can be either separated or superimposed for individual study. This is accomplished through the use of two individually controlled inputs working through amplifier, multivibrator, and blocking stages. The output of the Electronic Switch is connected directly to the vertical input of the Oscilloscope. A typical example of usefulness would be simultaneous observation of a signal or waveform as it appears at both the input and output stages of an amplifier.

APPLICATIONS

An Electronic Switch has many applications to increase the over-all operating versatility of your oscilloscope. It can be used to check amplifier distortion—audio crossover networks—phase inverter circuits—to measure phase shift—special waveform study, etc. The instrument can also be conveniently used as a square wave generator over the range of switching frequencies, often providing the necessary wave form response information without incurring the expense of an additional instrument. Ownership of this instrument will reveal many entirely new fields of oscilloscope application and will quickly justify the modest cost of the Electronic Switch Kit.

Heathkit VOLTAGE CALIBRATOR KIT



MODEL VC-2

$11.50

Shpg. Wt. 4 lbs.

Another useful oscilloscope accessory particularly in circuit development work and in TV and radio service work. The Voltage Calibrator provides a convenient method for making peak-to-peak voltage measurements with an oscilloscope, by establishing a relationship on a comparison basis between the amplitude of an unknown wave shape and a known output of the voltage calibrator. Peak-to-peak voltage values are read directly from a calibrated panel scale without recourse to involved calculations.

FEATURES:
To off-set line voltage supply irregularities, the instrument features a voltage regulator tube. A convenient "signal" position on the panel switch by-passes the calibrator completely and the signal is applied through the oscilloscope vertical input, thereby eliminating the necessity for constantly transferring test leads.

RANGES:
With the Heathkit Voltage Calibrator it is possible to measure all types of complex waveforms within a voltage range of .01 to 100 volts peak-to-peak. Build this instrument in a few hours and enjoy the added benefits offered only through combination use of test equipment.

Heathkit LOW CAPACITY PROBE KIT

No. 342

$3.50

Shpg. Wt. 1 lb.

An oscilloscope accessory, the 342 Low Capacity Probe permits observation of complex TV waveforms without distortion. An adjustable trimmer provides proper matching to any conventional scope input circuit. Excellent for high frequency, high impedance, or broad bandwidth circuits. The attenuation ratio can be varied to meet individual requirements.

Heathkit SCOPE DEMODULATOR PROBE KIT

No. 337-C

$3.50

Shpg. Wt. 1 lb.

Extend the usefulness of your oscilloscope by observing modulation envelopes of RF or IF carriers found in TV and radio receivers. The Heathkit Demodulator Probe will be helpful in alignment work, as a gain analyzer and a signal tracer. Easy construction with the new modern printed circuit board. Voltage limits are 30 volts RMS and 500 volts D.C.

HEATH company

BENTON HARBOR 15, MICHIGAN

Mac's Radio Service Shop

(*Continued from page* 80)

us to install them, you would charge him the regular service charge for the job *plus* the profit normally made on the sale of new condensers?"

"That's it exactly. It is the only way of doing it so that the job can be made to bring in its fair share of service income."

"I don't think the customer's gonna like it," Barney said dubiously.

"Possibly not," Mac agreed with a broad grin, "but he would like it even less if I tried to take advantage of a situation that would cause a reduction in *his* income. You've got to keep in mind the important commodity a service technician has for sale is his know-how. If he sells that cheap, he is a fool. If I put in the customer's condensers at just the usual service charge, I'm guilty of selling my knowledge—which he lacks, or he would put them in himself—cheaply."

"You're right, of course," Barney agreed. "But who do you think is really to blame in this discount business? Is it the man who operates the store, the manufacturer who sells to him, or the guy who buys from the store?"

"I blame no one," Mac said amiably. "Certainly you can hardly blame the store operator for seizing an opportunity to make money. After all, he simply depends upon greatly increased volume to compensate for the small mark-up he uses. That's no sin. And he must be satisfying a real demand or he wouldn't be in business. By putting out a complete and well-illustrated catalogue he enables his customers to compare one product with another and to buy more intelligently. These catalogues are especially helpful to service technicians who live in isolated areas and have to depend upon mail order service to get all of their parts. What's more, these mail order houses compete keenly with one another and so serve to bring down prices.

"Neither can I blame the people who buy from these stores. It is a good old American privilege to be able to drive your pigs to the best market. If a fellow buys parts that he can install himself, I have no quarrel with him. On the other hand, if he buys them and then expects me to install them at the same price I would charge for putting in my own parts, he is going to be disappointed.

"Personally, I prefer to buy from my regular distributor for a number of reasons: first, he goes out of his way to keep me informed on all new products that come out, even going so far as to send samples along with the salesman for my inspection. Secondly, he conducts meetings for service technicians at which leading authorities talk about various problems in servicing radio, black-and-white TV, and color TV sets. If I get a little short of cash, he is perfectly willing

NEW *Heathkit*

5" PUSH-PULL

OSCILLOSCOPE KIT

FOR COLOR TV

First color television service Oscilloscope with necessary high sensitivity and full 5 megacycle bandwidth.

New 5UP1 CR tube

New printed circuit construction, all components mounted on high insulation surface resulting in uniformly low circuit capacities.

New type wide frequency range Heath sweep generator, 10 cycles to 500,000 cycles.

New cabinet styling and color harmony—charcoal gray panel with high readability white lettering.

New electronic positioning controls for instantaneous, definite positioning without bounce or overshoot.

BRAND NEW DESIGN: The new Heathkit Model O-10 Oscilloscope would be something special at any price, but is almost unbelievable at $69.50. Completely re-designed scope has broadband amplifiers for color TV work and offers brilliant overall performance. Vertical frequency response within 5 db from 5 cps to 5 mc. Even more astounding, the response is down less than 1½ db at 3.58 mc. the color TV sync burst frequency. It is essential that scopes for color work have these broadband characteristics.

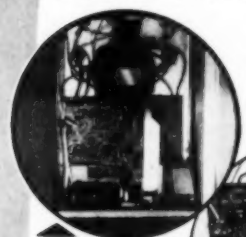
PRINTED CIRCUITS: Two printed circuit boards used in this fine instrument to insure stable, consistent performance. Problems solved by pre-engineering of boards, and their use guarantees completed unit that will have same characteristics as lab development model. Printed circuits simplify construction and save labor.

NEW SWEEP CIRCUIT: Sweep circuit operates with exceptionally good linearity from 20 cps to over 500,000 cps, 5 times the usual range for scopes in this price range. An entirely new circuit introduced for the first time in any Heathkit.

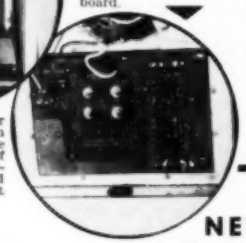
MODEL O-10

$69.50

Shpg. Wt. 27 lbs.



Simplified, standardized construction technique of vertical and horizontal amplifier construction made possible through the use of a single *printed circuit* board.



Clean, open, under chassis construction and wiring. Possible only through use of pre-cabled wiring harness, and simplified printed circuit boards.

FEATURES: Other outstanding characteristics of this professional oscilloscope are: Built-in 1V peak-to-peak reference for calibration of plastic CRT face-plate; 5" 5UP1 CRT; push-pull hor. and vert. deflection amplifiers; hor. trace width expandable to 3 times diameter of CR tube to allow inspection of any small portion of the signal; deflection sensitivity, .025 volts per inch; wiring harness pre-formed and cabled to save construction time and insure professional appearance and operation. Incorporates efficient retrace blanking. Frequency compensated step attenuator at the vertical input. Entire tube face useable. No foldover on vertical over-load. Performance obtainable only in much more expensive laboratory models.

Uses 5UP1, 6AB4, 6BQ7, 12BH7, 6CB6, 12AT7, 2-12AU7, 6X4, 1V2, and 6C4. Quality components used throughout so that outstanding performance characteristics may be maintained for years to come. Plastic molded condensers are used in all coupling and by-pass applications. The "new-look" in Heathkit styling produces professional appearance in keeping with the professional performance of this instrument.

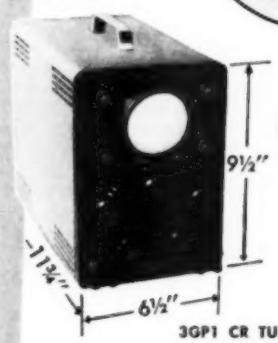
NEW *Heathkit*

3" PRINTED CIRCUIT

OSCILLOSCOPE KIT

MODEL OL-1

$29.50 Shpg. Wt. 15 lbs.



3GP1 CR TUBE

New compact utility Scope—lightweight—portable for service work.

Deflection plate terminals—ideal for ham transmitter modulation monitoring.

New easy-to-build printed circuit board with high insulation factor.

New Heathkit instrument styling—charcoal gray panel with high readability white lettering.

New Heath twin triode sweep generator 15–100,000 cycle sweep.

EXCEPTIONAL VALUE: The brand new Model OL-1 Utility Oscilloscope is designed especially for portable applications so that outside servicemen or persons performing field tests can have the advantages of a scope available. Then too, it is ideal for home workshop, the ham-shack, or as an "extra" scope for the service shop. It is compact, light in weight, and surprisingly versatile in operation. An outstanding instrument for the price.

Front panel controls are "bench-tested" for ease of operation and convenience. Printed circuit board used for constant circuit performance. Assembly time cut in half!

SPECIFICATIONS: Vertical amplifiers feature frequency response within 1 db from 10 cps to 100 kc, and within 5 db from 5 cps to 500 kc. Vertical sensitivity .2 volts per inch at 1 kc, with input impedance of 12 mmfd shunting 10 megohms.

Horizontal response within 1 db from 10 cps to 200 kc, and within 5 db from 5 cps to 500 kc. Hor. sensitivity .25 volts per inch at 1 kc, input impedance of 15 mmfd shunting 10 megohms. Sweep generator covers 10 cps to 100,000 cps with stable positive lock-in circuit. Cathode follower input in both vert. and hor. amplifiers; push-pull vertical and horizontal deflection amplifiers; 3" CRT; electronic positioning controls for wide range of vertical and horizontal spot deflection; provision for internal and external sync; 60 cycle line sweep. New modern color styling and unusual performance make this instrument an outstanding value.

NEW *Heathkit*

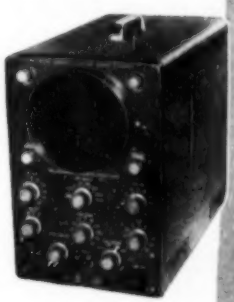
5" PRINTED CIRCUIT

OSCILLOSCOPE KIT

MODEL OM-1

$39.50 Shpg. Wt. 24 lbs.

5BP1 CR TUBE



VERSATILE INSTRUMENT: The new Model OM-1 general purpose Oscilloscope represents an outstanding dollar value in reliable test equipment. Full 5 inch CRT. Printed circuit boards for ease of assembly, constant circuit characteristics, and rugged component mounting. Includes all the design features necessary for servicemen, students, experimenters, radio amateurs, etc. Frequency response of amplifiers flat within 1 db from 10 cps to 100 kc, and down only 7 db from 10 cps to 500 kc. Sweep generator range from 20 cps to 100,000 cps. Also features new Heathkit color styling with charcoal gray panel and high definition white lettering for readability even under subdued lighting conditions.

DESIGN FEATURES: A full-size, versatile oscilloscope at a price you can afford. Other features are: adjustable spot shape control; RF connections to deflection plates; direct coupled centering controls; external and internal sweep and sync; 60 cycle line sync; built in 1 volt peak-to-peak panel terminal reference voltage; professional appearance of cabinet, panel, and knob styling.

HEATH company

BENTON HARBOR 15, MICHIGAN

Heathkit MULTIMETER KIT

20,000 ohms per volt sensitivity DC; 5,000 ohms per volt AC.

Polarity reversal switch eliminates transferring of test leads.

All 1% precision multiplier resistors—sensitive 50 microamp 4½" square bimpson meter.

Total of 35 meter ranges on two color scale.

The new Heathkit Multimeter is a "must" to complete the instrument lineup of any well equipped service shop. Here is an instrument packed with every desirable service feature, many of which are not found in other Multimeters. All of the measurement ranges you need or want. High sensitivity 20,000 ohms per volt DC; 5,000 ohms per volt AC.

New modern cabinet styling—attractive appearance.

MODEL MM-1

$26.50

Shpg. Wt. 6 lbs.

★ **ADVANTAGES**

Complete portability through freedom from AC line power operation—provides service ranges of direct current measurements from 150 microamps up to 15 amperes—can be safely operated in RF fields without impairing accuracy of measurement.

★ **RANGES**

Full scale AC and DC voltage ranges are 0–1.5, 5, 50, 150, 500, 1500 and 5,000 volts. Direct current ranges are 150 microamps, 15, 150 and 500 milliamperes and 15 amperes. Resistances are measured from .2 ohms to 20 megohms in 3 ranges and db range from −10 to +65 db.

★ **CONSTRUCTION**

The Heathkit MM-1 features a unique resistor ring switch mounting assembly procedure. With this method of assembly the precision resistors are wired to the rings and range switch before actual mounting of the switch to the instrument panel. This procedure affords the advantage of simpler construction yet complete accessibility of precision resistors in event replacement is ever required. Ohmmeter batteries were selected for convenience of replacement and only standard commercially available types are used. Batteries consist of 1 type C flashlight cell and 4 Penlite cells. All batteries and necessary test leads are furnished with the kit.

Heathkit HANDITESTER KIT

MODEL M-1

$14.50

Shpg. Wt. 3 lbs.

The Heathkit Model M-1 Handitester readily fulfills major requirements for a compact, portable volt-ohm milliammeter. The small size of the smooth gleaming molded bakelite case permits the instrument to be tucked into your coat pocket, toolbox or glove compartment of your car. Always the "Handitester" for those simple repair jobs.

RANGES:

Despite its compact size, the Handitester is packed with every desirable feature required in an instrument of this type. AC or DC voltage ranges, full scale, 10, 30, 300, 1,000 and 5,000 volts. 2 convenient ohmmeter ranges 0–3,000 ohms and 0–300,000 ohms. 2 DC milliammeter ranges 0–10 milliamperes and 0–100 milliamperes.

CONSTRUCTION

The instrument uses a 400 microampere meter movement which is shunted with resistors to provide a uniform 1 milliampere load in both AC and DC ranges. This design allows the use of but 1 set of 1% precision divider resistors on both AC and DC and provides a simplicity of switching. A small hearing aid type ohms adjust control provides the necessary zero adjust function on the ohmmeter range. The AC rectifier circuit uses a high quality Bradley rectifier and a dual half wave hookup. Necessary test leads and battery are included in the price of this popular kit.

Heathkit RESISTANCE SUBSTITUTION BOX KIT

MODEL RS-1

$5.50

36 standard RTMA 1 watt resistor values between 15 ohms and 10 megohms with an accuracy of 10% are at your fingertips in the Model RS-1 Resistance Substitution Box kit. This sturdy and attractive accessory will easily prove its worth many times over as a time saving device. Order several today.

Shpg. Wt. 2 lbs.

Heathkit CONDENSER SUBSTITUTION BOX KIT

MODEL CS-1

18 standard RTMA values are available from .0001 mfd to .22 mfd. An 18 position switch set in the panel of an attractive bakelite case allows quick changes without touching the test leads. Invest a few minutes of your time now and save hours of work later on.

$5.50

Shpg. Wt. 2 lbs.

HEATH company

BENTON HARBOR 15, MICHIGAN

to carry me for a month or so. Back when tubes were tight and I could not obtain scarce types from the mail order houses, my distributor saw to it I got my fair share. Finally, if I receive a defective part, I simply hand it back to the salesman and promptly get a new one in exchange. There's no wrapping up, mailing back, and so on.

"To me these are all valuable services that I appreciate, and I try to show my appreciation by buying all I can from the distributor. At the same time I occasionally buy a particular part not carried by my distributor from one of the mail order houses, and the service I get on these orders is usually prompt and satisfactory; so I have no crow to pick with them. It is highly possible I might feel differently about these stores if the major part of my income came from sales instead of service, but as long as most of our customers have to call on us to install the parts they buy, we are not going to be hurt much. I could find it in my heart to wish they would not mail out these catalogues to every Tom, Dick, and Harry who requests one; but maybe it wouldn't be practical to try to sort the deserving from the undeserving."

"How about the manufacturer who sells to the wholesale house when he knows it is going to sell those parts to anyone who wants them at far below list price? Isn't that being unfair to technicians who are expected to sell the same parts at list?"

"In a way it is, but you must admit there are extenuating circumstances. Keep in mind the wholesale house will buy a carload of parts for every hatful the individual technician buys. What's more, the wholesale house will picture and describe the good features of that product in a catalogue mailed all over the world free of any extra expense to the manufacturer. It's asking almost too much of human nature to expect a manufacturer to turn down a proposition like that.

"All in all," Mac concluded as he heaved the stool on four legs, "there must be room for both the mail order wholesale house and the regular distributors or both would not have flourished all these years. For the legitimate technician, the mail order house is just another handy source of needed parts. As for the fellow not really eligible to receive a discount on radio parts but who buys from one of these catalogues anyway, thinking he is saving money, I know from long observation he will buy enough wrong parts or ruin right ones trying to install them without sufficient knowledge so he will waste money instead of saving it."

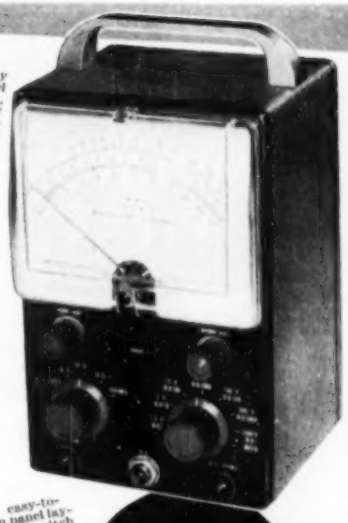
"Yeah," Barney agreed as he slid off the bench. "It's just like the guy who tries to beat the doctor out of a fee and prescription by dosing himself with patent medicines. He ends up going to the doctor anyway after he has squandered the cost of several fees doing his own doctoring." —30—

NEW Heathkit VACUUM TUBE VOLTMETER KIT

PRINTED CIRCUIT DESIGN

New charcoal gray baked enamel panel with high readability, white lettering. New soft feather gray cabinet, subdued pilot light indicator.

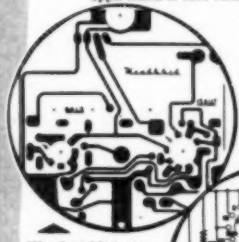
New printed circuit board for faster, easier construction—exact duplication of Lab development model.



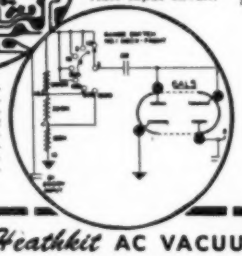
Another outstanding example of continuing Heath Company pioneering and leadership in the kit instrument field. A new **printed circuit** VTVM. New peak-to-peak circuit—new styling and new panel design. A prewired, prefabricated printed circuit board eliminates chassis wiring, cuts assembly time in half, assures duplication of Engineering pilot model specifications, and virtually eliminates possibility of construction error.

CIRCUIT:

A 6AL5 tube operated as a full wave AC input rectifier permits seven peak-to-peak voltage ranges with upper limits of 4000 volts P—P. Just the ticket for you TV servicemen. Voltage divider in the 6AL5 input circuit limits applied AC input to a safe level. This circuitry and the isolation of the meter in the cathode of the 12AU7 bridge circuit affords a high degree of protection to the sensitive 200 microampere meter.



Full wave rectifier in AC input circuit. Read peak-to-peak and RMS volts with upper limit of 4000 P—P and 1500 volts RMS. Voltage divider input circuit.



The first kit instrument to offer a labor-saving, error-free *printed circuit* board. Your instrument an exact wiring replica of Engineering development model.

RANGES:

Seven voltage ranges, 1.5, 5, 15, 50, 150, 500 and 1,500 volts DC and AC RMS. Peak-to-peak ranges 4, 14, 40, 140, 400, 1400, 4000. Ohmmeter ranges X1, X10, X100, X1000, X10K, X100K, X1 meg. Additional features are a db scale, a center scale zero position, and a polarity reversal switch.

New easy-to-read open panel layout. Off-on switch now incorporated in the selector switch.

MODEL V-7

$24.50

Shpg. Wt. 7 lbs.

IMPORTANT FEATURES:

High impedance 11 megohm input—transformer operated—1% precision resistors, 6AL5 and 12AU7 tube—selenium power rectifier—individual AC and DC calibrations—smoother improved zero adjust control action—new panel styling and color—new placement of pilot light—new positive contact battery mounting—new knobs—test leads included.

The new V-7 also sets the pace as a kit instrument style leader. Smart, good-looking charcoal gray panel and soft feather gray cabinet. High readability panel with sharply contrasting white calibrations. The pleasing, eye catching, modern styling is in harmonious balance with the outstanding circuit design improvements. Easily the best buy in kit instruments.

New peak-to-peak meter scale—new color harmony—new knobs.

Heathkit AC VACUUM TUBE VOLTMETER KIT

MODEL AV-2

$29.50 Shpg. Wt. 5 lbs.

Extreme sensitivity has been emphasized in the design of the Heathkit AC VTVM. Ten full scale RMS ranges are .01, .03, .1, .3, 1, 3, 10, 30, 100, and 300 volts. Frequency response is substantially flat from 10 cycles per second to 50 KC with input impedance of 1 megohm at 1 KC. Will accurately measure as low as 1 millivolt at high impedance. Total db range is —52 db to +52 db. An excellent kit for measuring the output of phono cartridges and the gain of amplifier stages. Use it also to check power supply ripple, as a sensitive null detector, and for compiling frequency response data. Features one knob operation, 200 microampere Simpson meter and precision resistors.

Heathkit 30,000 VOLTS DC PROBE KIT

Measure up to 30,000 volts DC with the Heathkit VTVM and the 336 high voltage Probe. Precision resistor provides multiplication factor of 100. Can be used with any 11 megohm input VTVM. Housed in a Polystyrene two color sleek plastic probe body for safety of operation.

No. 336

$4.50

Shpg. Wt. 1 lb.

Heathkit PEAK-TO-PEAK PROBE KIT

No. 338-C

$5.50

Shpg. Wt. 2 lbs.

Peak-to-peak values not exceeding 80 volts at a DC level of not more than 600 volts, can now be read directly by using 338-C Probe with previous model Heathkit VTVM's or any VTVM with 11 megohm input resistance. Probe construction features a modern printed circuit board for easy assembly. Frequency range 5 KC to 5 MC.

Heathkit RF PROBE KIT

The Heathkit RF Probe will permit the measurement of RF voltages up to 250 MC with an accuracy of ±10%. The limits are 30 volts AC and a DC level of 500 volts. Designed for any 11 megohm input VTVM. Modern styling. Polystyrene aluminum housing. Polystyrene insulation, and printed circuit board for easy assembly.

No. 309-C

$3.50 Shpg. Wt. 1 lb.

Heathkit AUDIO WATTMETER KIT

Read audio power output directly without using external load resistors with the new Heathkit Audio Wattmeter. Built-in non-inductive load resistors provide impedances of 4, 8, 16, and 600 ohms. Flat response from 10 CPS to 250 KC. Full scale power ranges are 0-5 MW, 0-50 MW, 0-500 MW, 0-5 W and 0-50 W. Model AW-1 will operate continuously at 25 watts and has a duty cycle of 3 minutes at 50 watts. Total db range in five positions is —50 db to +48 db, using the standard 1 milliwatt 600 ohms.

MODEL AW-1

$29.50

Shpg. Wt. 6 lbs.

HEATH company

BENTON HARBOR 15, MICHIGAN

Heathkit 6-12 VOLT

BATTERY ELIMINATOR KIT

Automatic overload relay—self resetting—fuse protected.
New 18 plate split type heavy duty rectifier unit.
Continuously variable output voltage, either 6 or 12 volt operation.
Constant ammeter and voltmeter monitoring.

Here is the new 12 volt Heathkit Battery Eliminator so necessary for modern up-to-date operation of your Service Shop. Furnishes either 6 or 12 volt output which can be selected at the flick of a panel switch. Use the BE-4 to service all of the new 12 volt car radios in addition to the conventional 6 volt models.

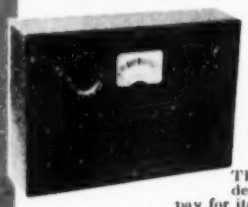
RANGES:
This new Battery Eliminator provides two continuously variable output voltage ranges. 0-6 volts D.C. at 10 amperes continuously or 15 amperes maximum intermittent and 0-12 volts D.C. at 5 amperes continuously or 7.5 amperes maximum intermittent. The output voltage is clean and well filtered, as the circuit uses two 10,000 mfd condensers.

The continuously variable voltage output feature is of definite aid in determining the starting point of vibrators, the voltage operating range of oscillator circuits, etc.

MODEL BE-4
$31.50
Shpg. Wt. 17 lbs.

OTHER USES:
The controllable low voltage DC supply has many other applications besides primary use in car radio service work. Can be nicely used as a battery charger, or low voltage DC supply for electric trains. Has applications in high gain audio work requiring clean DC filament supply. Can be used for low power electro-plating or as a power supply for battery powered intercommunication systems.

Heathkit
VIBRATOR TESTER KIT



MODEL VT-1
$14.50
Shpg. Wt. 6 lbs.

This time-saving device will quickly pay for itself in your auto radio service shop. 6 volt vibrators can be checked instantly on the *Good—Bad* type meter scale. Operation requires only a variable DC voltage from 4 to 6 volts at 4 amperes. Model BE-4 Battery Eliminator is recommended for this application.

Five test sockets provide for the testing of hundreds of interrupter and self-rectifier types. Proper starting voltage is determined easily and accurately. Over-all quality is then unmistakenly indicated on the panel mounted meter.

Heathkit
IMPEDANCE BRIDGE KIT

MODEL IB-2
$59.50 Shpg. Wt. 12 lbs.

The new Heathkit Impedance Bridge features built-in adjustable phase shift oscillator and amplifier. This instrument actually represents four instruments in one compact unit. The Wheatstone bridge for resistance measurements, the Capacity Comparison bridge for capacity measurements, Maxwell bridge for low Q, and Hay bridge for high Q measurements.

DESIGN:
Panel provisions for external generator use. A new two section CRL dial, provides ten separate "units." Ten separate units switch settings and fractions of units are read on a continuously variable calibrated control. A special minimum capacity shielded and balanced impedance matching transformer between the generator and bridge circuit is automatically switched to provide correct load operation of the generator circuit. The instrument uses ½% precision resistors and condensers in all measurements circuits.

Heathkit VARIABLE VOLTAGE
ISOLATION TRANSFORMER KIT

Variable output voltage between 90 and 130 volts AC. Rated at 100 volt—amperes continuously and 200 volt—amperes intermittently. The principle function of the Heathkit Isolation Transformer is to isolate the circuit being tested from line interference being caused by motors, appliances, etc. It works backward too by isolating such devices from the line. Many other uses, especially with AC-DC type circuits. Do not confuse the Heathkit Isolation Transformer with the hazardous auto transformer type line voltage boosters.

MODEL IT-1
$16.50
Shpg. Wt. 10 lbs.

HEATH company
BENTON HARBOR 15, MICHIGAN

"Sending Iron"
(*Continued from page 46*)

driven into the base plate as tightly as it can be turned, about 1/32" should project through on the bottom. Hold the base flat on the edge of a table, top down, so the pivot is against the table edge, then peen the projecting rod over, rivet-wise. This will prevent the pivot from coming loose in the midst of some hot QSO.

Now use a coarse file to remove any screw ends projecting through the bottom, then glue on the sponge rubber "anchor" with rubber cement.

Cut off about 10 turns of a 3/8"-diameter medium-strength dial spring and straighten the bottom end out for 1" at a tangent. Straighten the same length of the top out in line with the spring axis, then drop the spring over the pivot.

Back off on the stop and contact screws, and slide the arm bearing down on the pivot. It should, of course, move with practically no friction.

Seat the tangential bottom end of the main spring against the dot-stop bracket, then wind the top of the spring one turn counterclockwise. Dip the upper end under the lever, then release it, which will force the lever lightly toward the right, or clockwise position. If all of the stop screws are backed off, this will bow the reed into a curve between the pendulum stop and pivot.

Turn the inner nut on the dash stop forcing the dash spring against the lever until the curve is taken out of the reed, which will now form a straight line, with the pendulum just lightly touching its stop. Holding the dash spring nut from any further movement, turn in the dash-stop screw until it is 1/16" from the lever. At this point, pressing the dash knob moves the lever through the short arc over to the dash stop.

On the other side, and with the lever at rest again, turn the dot stop until it is 1/16" from the lever. Pressing in the dot paddle should cause the pendulum to vibrate at quite a rapid rate, worth about 50 words-per-minute. Slip the weight on the pendulum and the speed will settle down to a comfortable pace. Now the bug should be connected to a buzzer and battery.

Turn the dash-contact screw in until it makes good solid dashes when the knob is pressed. With too light a contact, the contacts will chatter, and the characters will have fuzz on the "make." With the contact too close, the dashes will happen too soon. Get it just right.

Then hold in the dot paddle, and turn in the dot contact until good solid dots are formed. The proper location will be such that about ten respectable dots will run out before they begin to mush together. When the reed stops vibrating, the dot contacts should be lightly but definitely closed.

Now, press with the thumb for three

NEW *Heathkit* TV ALIGNMENT GENERATOR KIT

Controllable inductor sweep oscillator with output entirely on fundamentals.

Triple marker system 4.5 MC crystal controlled—3 sets of low loss, low capacity shielded cables included.

Electronically operated, smooth continuously variable, sweep circuit. No vibration, hum or noise.

Frequency coverage: 4 MC—220 MC continuous including FM spectrum. RF output well over .1 volt.

MODEL TS-3

$44.50

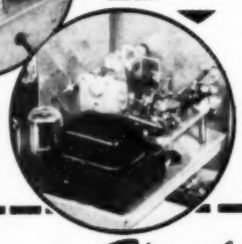
Shpg. Wt. 18 lbs.

Here is the most radically improved Sweep Generator in the history of the TV service industry. The basic design follows latest high frequency techniques which result in a combination of performance features not found in any other sweep generator.

SWEEP:

Sweep action is obtained electronically through the use of a newly developed controllable inductor, thereby eliminating all moving parts with their resultant hum, vibration, fatigue, etc. Frequency coverage entirely on fundamentals, is continuous from 4 MC to 220 MC at an output level well over a measurable .1 volt.

Triple marker system, 4.5 MC crystal controlled marker—continuously variable marker—provisions for external marker.



Automatic amplitude control circuit—constant output voltage regulated power supply.

MARKER:

The same instrument incorporates a triple marker system with a crystal controlled reference. A variable marker provides accurate coverage from 19 to 60 MC on fundamentals, and 57 to 180 MC on calibrated harmonics. A separate fixed crystal controlled 4.5 MC marker can be used for checking IF, bandpass, calibration, reference, etc. Provisions are also made for external marker use. A 4.5 MC crystal is supplied with the kit.

POWER SUPPLY:

The transformer operated Power Supply features voltage regulation for stable oscillator operation. Three sets of shielded cables are furnished with the kit. Sweep range is completely and smoothly controllable from zero up to a maximum of 50 MC, depending upon base frequency.

Here is a TV Sweep Generator that truly no serviceman can afford to be without for rapid, accurate, TV alignment work.

NEW *Heathkit* SIGNAL GENERATOR KIT

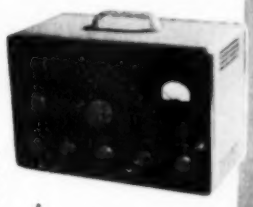
MODEL SG-8

$19.50 Shpg. Wt. 8 lbs.

The new Heathkit service type Signal Generator, Model SG-8 incorporates many design features not usually found in this instrument price range. Frequency coverage is from 160 KC to 110 MC in five ranges, all on fundamentals, with useful calibrated harmonics up to 220 MC. The RF output level is well in excess of 100,000 microvolts throughout the frequency range. The oscillator circuit consists of a twin triode tube, one-half used as a Colpitts oscillator, and the other half as a cathode follower output which acts as a buffer between the oscillator and external load, thereby eliminating oscillator frequency shift usually caused by external loading.

All coils are factory wound and adjusted, thereby completely eliminating the need for individual calibration and the use of additional calibrating equipment. The stable, low impedance output, features step and variable attenuation for complete control of RF level. A separate 6C4 triode acts as a 400 cycle sine wave oscillator, and a panel mounted switching system permits choice of either external or internal modulation.

Heathkit LABORATORY GENERATOR KIT



MODEL LG-1

$39.50

Shpg. Wt. 16 lbs.

The new Heathkit Laboratory type Signal Generator definitely establishes a new performance standard for a kit instrument. An outstanding feature involves the use of a panel mounted 200 microampere meter calibrated both in microvolts and percent modulation, thereby providing a definite reference level for using the Signal Generator in design work, gain measurements, selectivity, frequency response checks.

DESIGN:

Additional design features are copper plated shield enclosure for oscillator and buffer stages resulting in effective double shielding. Fibre panel control shaft extensions in RF carrying circuits, thorough AC line filtering, careful shielding of the attenuator network, voltage regulated B plus supply, selenium rectifier, etc.

RANGES:

Frequency coverage from 150 KC to 30 MC all on fundamentals in five separate ranges. Output voltage .1 volt with provisions for metered external or internal modulation. Output impedance termination 50 ohms. Transformer operated power supply.

Investigate the many dollar stretching features offered by the LG-1 before investing in any generator for Laboratory or Service work.

NEW *Heathkit* BAR GENERATOR KIT

MODEL BG-1

$14.50 Shpg. Wt. 4 lbs.

The Heathkit BG-1 produces a series of horizontal or vertical bars on a TV screen. Since these bars are equally spaced, they will quickly indicate picture linearity of the receiver under test without waiting for transmitted test patterns. Panel switch provides "standby—horizontal and vertical position." The oscillator unit uses a 12AT7 twin triode for the RF oscillator and video carrier frequencies. A neon relaxation oscillator provides low frequency for vertical linearity tests. The instrument will also provide an indication of horizontal and vertical sync circuit stability as well as overall picture size. Operation is simple and merely requires connection to the TV receiver antenna terminal. Transformer operated for safety.

HEATH company

BENTON HARBOR 15, MICHIGAN

Heathkit
VISUAL-AURAL
SIGNAL-TRACER KIT

Substitution test speaker—utility amplifier.
Noise locator circuit—calibrated wattmeter.
RF and audio probes supplied along with necessary test leads.
Visual and aural signal tracing.

The new Heathkit Visual-Aural Signal Tracer features a special high gain RF input channel used in conjunction with a newly designed wide frequency range demodulator probe. High RF sensitivity permits signal tracing from the receiver antenna input. Separate low gain channel and probe available for audio circuit exploration. Both input channels are constantly monitored by an electron ray beam indicator so that visual as well as aural indications may be obtained.

NOISE LOCATOR:
A decidedly unusual feature is a noise locator circuit used in conjunction with the audio probe. With this system, a DC potential is applied to a suspected circuit component and the action of the voltage in the component can be seen as well as heard. Invaluable for ferreting out noisy or intermittent condensers, noisy resistors, controls, IF and power transformers, etc.

MODEL T-3
$23.50
Shpg. Wt. 9 lbs.

WATTMETER:
Built-in calibrated wattmeter circuit will prove useful for quick preliminary check of total wattage consumption of equipment under test. Separate panel terminals provide external use of the speaker or output transformer for substitution purposes. Saves valuable service time by eliminating the necessity for speaker removal on every service job. The same panel terminals also provide easy access to a well filtered B plus supply for external use. Don't overlook the many interesting service possibilities provided through the use of this instrument, and let the Signal Tracer work for you by saving time and money.

Heathkit CONDENSER CHECKER KIT

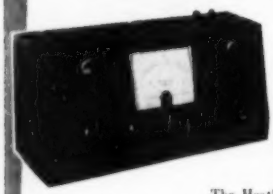
MODEL C-3
$19.50 Shpg. Wt. 7 lbs.

Here is a handy test instrument for any Service Shop. Unknown values of capacity and resistance are quickly determined on the direct reading condenser checker dial. Capacity is measured in four ranges from .001 mfd to 1000 mfd. Resistance in the range from 100 ohms to 5 megohms.

DC polarizing voltages of 25, 150, 250, 350, and 450 volts are available for leakage tests on all types of condensers. For electrolytes, a power factor control is provided to balance out inherent leakage and to indicate directly the power factor of a condenser under test. Proper balancing of the AC bridge is reflected in the degree of closure of an electron beam indicator tube.

Model C-3 uses a transformer operated power supply, spring return leakage test switch, and a convenient combination of panel scales for all readings. Test leads are furnished in addition to precision components for calibrating purposes. Quick and easy to operate, the Heathkit Condenser Checker will save valuable time and increase your Shop efficiency.

Heathkit "Q" METER KIT



MODEL QM-1
$44.50
Shpg. Wt. 14 lbs.

The Heathkit QM-1 represents the first practical popular priced Q meter available within the price range of schools, laboratories, TV service men, and experimenters. This instrument will enable the operator to simulate conditions encountered in practical circuits and to measure the performance of coils or condensers at the operating frequencies actually encountered. All indications of value are read directly on the 4½" 50 microampere Simpson calibrated meter scale. Measures Q of condensers, RF resistance, and the distributed capacity of coils. Oscillator section supplies RF frequencies 150 KC to 18 MC in four ranges. Calibrate capacity with range of 40 MMF to 450 MMF with vernier of ±3 MMF. Investigate the many services this instrument can perform for you.

Heathkit AUDIO OSCILLATOR KIT

MODEL AO-1
$24.50
Shpg. Wt. 10 lbs.

The Heathkit Audio Oscillator will produce both sine and square waves within the frequency range from 20 CPS to 20 KC in three ranges. Thermistor controlled linearity results in a variation of no more than ±1 db in a 10 volt (no load) variable output level. There will be less than .6% distortion from 100 CPS throughout the audible range. Low impedance 600 ohm output. Precision 1% resistors, used in the range multiplier circuits to provide accurate calibration.

HEATH company
BENTON HARBOR 15, MICHIGAN

blips, then with the first two fingers on the knob for exactly the same length of time. This forms a correctly proportioned "V" and indicates the proper length of dash for the dot speed in use. Remember this—and if you fall into the bad habit of using some other proportion, it is cheating. Your dots may be burping out at 40, but the words aren't.

Exact adjustment from here on is a matter of taste, arrived at by juggling all of the controls. When it feels best, tighten the lock nuts, and drop on some sealing wax if you're that fussy.

Practice with the buzzer until what comes out can be read by some one other than a close friend. Then, your sending iron is ready for the air. Don't be upset if you don't sound like WSL press. A little personality is just as legitimate in sending Morse as in any other form of human expression. But whether your sending is informal or so machinelike it comes in with a whiff of hot oil, this little sending iron will project it as well as many a bug that costs *money*. -30-

DIRECTIONAL TV ANTENNA

By EDWARD S. HECK

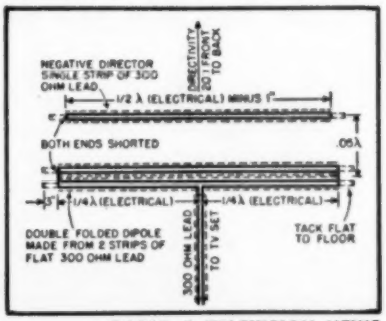
FEATURING a front-to-rear ratio of 20:1 with small size, the antenna shown in the accompanying diagram has proved useful to the writer in eliminating r.f. oscillation and other types of interference. It is recommended as an improvement over built-in antennas in strong signal locations, and particularly where the introduction of u.h.f. has brought about the problem of the re-radiating converter.

The principle of a negative director element to get high front-to-back ratio is well known. The director, in effect, subtracts from the back signal rather than adding to the front signal, achieving a highly single-directional effect without adding to the total gain.

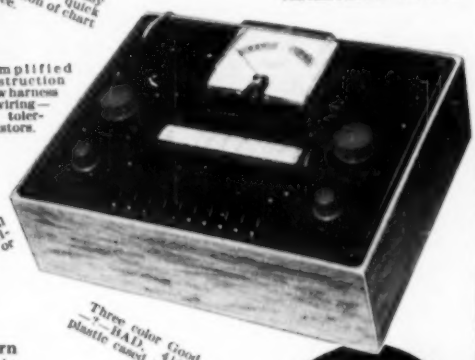
The small size of the antenna makes it ideal for under-the-rug installation. This has the added advantage that it results in a broadening of the response of the antenna. You will be surprised, as was the writer, by the definite improvement in picture detail, clarity, and apparent depth when a resonant antenna is broadened in this manner.

For best results, the antenna should be cut and directed for a single station. Element lengths will be around 80% of free space values due to decreases in the velocity factor when flat on the floor. -30-

Directional TV antenna cut from 300-ohm twin-lead for use indoors on the floor.


NEGATIVE DIRECTOR SINGLE STRIP OF 300 OHM LEAD
1/2 λ (ELECTRICAL) minus 5%
DIRECTIVITY 20:1 FRONT TO BACK
BOTH ENDS SHORTED
.05λ
5"
1/4λ (ELECTRICAL)
1/4λ (ELECTRICAL)
DOUBLE FOLDED DIPOLE MADE FROM 2 STRIPS OF FLAT 300 OHM LEAD
300 OHM LEAD TO TV SET
TACK FLAT TO FLOOR

Heathkit TUBE CHECKER KIT


Illuminated for easy reading and quick identification of chart reference.
Improved smooth running roll chart mechanical action.
Simplified construction —new harness type wiring— closer tolerance resistors.
Smart, professional appearance—available in counter or portable models.
Three color Good —Bad— Fair plastic cased meter.

The Heathkit TC-2 Tube Checker was primarily designed for the convenience of radio and TV servicemen and will check the operating quality of tubes commonly encountered in this type of work. Test set-up procedure is simplified, rapid, and flexible. Panel sockets accommodate 4, 5, 6, and 7 pin tubes, octal and loctal, 7 and 9 pin miniatures, 5 pin Hytron, and a blank socket for new tubes. Built-in neon short indicator, individual 3-position lever switch for each tube element, spring return test switch, 14 filament voltage ranges, and line-set control to compensate for supply voltage variations, all represent features of the TC-2.

Results of tube tests are read directly from the large 4½" Simpson 3-color meter. Checks emission, shorted elements, open elements, and continuity. Wiring procedure has been simplified through the use of multi-wired color coded cable providing a harness type installation between tube sockets and lever switches. This procedure insures standard assembly and imparts a "factory built" appearance to the instrument. New Construction Manual furnishes detailed information regarding tube set-up procedure for testing of new or unlisted tube types. No delay necessary for release of factory data.

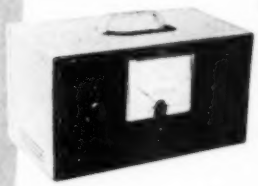
MODEL TC-2
$29.50
Shpg. Wt. 12 lbs

Heathkit PORTABLE TUBE CHECKER KIT

The portable model is supplied with a strikingly attractive two-tone cabinet finished in rich maroon proxylin impregnated fabric covering with a contrasting gray on the inside of the detachable cover.

MODEL TC-2P
$34.50
Shpg. Wt. 15 lbs.

Heathkit REGULATED POWER SUPPLY KIT



MODEL PS-2
$33.50 Shpg. Wt 15 lbs.

Here is a source of regulated D.C. voltage for circuit development work. Power supply voltage and current drain to the circuit under test are constantly monitored by the 4½" panel mounted meter. Separate 6.3 volt at 4 ampere A.C. filament source available. The regulated and variable output voltage will be constant over wide load variations, and hum ripple will not exceed .012% at 250 volts under a 50 MA load. Completely isolated circuit, standby switch, and other desirable features, make the Model PS-2 extremely useful in a wide variety of applications.

Heathkit TV PICTURE TUBE TEST ADAPTER

The Heathkit TV Picture Tube Test Adapter used with the Heathkit Tube Checker Kit, will quickly check picture tubes for emission, shorts, etc. and determine tube quality. Consists of standard 12-pin TV tube socket, four feet of cable, octal socket connector, and data sheet.

No. 355
$4.50 Shpg. Wt. 1 lb.

Heathkit DECADE RESISTANCE KIT

MODEL DR-1
$19.50
Shpg. Wt. 4 lbs.

Twenty 1% resistors are decaded in 1 ohm steps to provide any value between 1 ohm and 99,999 ohms. Sturdy ceramic switches with silver plated contacts insure reliable service. Use the Decade Resistance in bridge circuits, meter multipliers, calibrations, or any application requiring a wide range of precision resistance values.

Heathkit AUDIO GENERATOR KIT

Here is an Audio Generator with features generally found only in the most expensive instruments. Sine wave coverage from 20 cycles to 1 Megacycle—response flat ±1 db from 20 cycles to 400 Kc—continuously variable and step attenuated output. Because the output voltage is relatively constant over wide frequency ranges, the AG-8 is ideal for running frequency response curves in audio circuits. Once set by means of the attenuator, this voltage may be relied upon for accuracy within ± 1 db. Instrument features low impedance 600 ohm output circuit and distortion less than .4 of 1% from 100 CPS through audible range.

MODEL AG-8
$29.50
Shpg. Wt. 11 lbs.

Heathkit DECADE CONDENSER KIT

The Heathkit Decade Condenser provides a ready source of capacity values from 100 mmf to .111 mfd inclusive in capacity steps of 100 mmf. Silver plated contacts on husky ceramic switches, assure positive contact for each switch position. Precision silver mica condensers ±1% accuracy for close tolerance accurate work.

MODEL DC-1
$16.50
Shpg. Wt. 3 lbs.

HEATH company
BENTON HARBOR 15, MICHIGAN

NEW *Heathkit* HIGH FIDELITY

PREAMPLIFIER KIT

Equalization for LP, RIAA, AES, and early 78.
Separate bass and treble tone controls—special hum control.
Cathode follower low impedance output circuit.
Beautiful, modern appearance, blends with any interior color scheme.
Five switch selected inputs with individual level controls.

Here is the exciting new Heathkit Preamplifier with all of the features you Audiophiles have asked for and at a down-to-earth price level. Beautiful satin gold baked enamel finish, striking control knobs and arrangement, attractive custom appearance and entirely functional design.

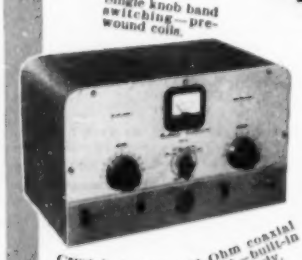
DESIGN:
Uses three twin triode tubes in a shock mounted chassis, 2-12AX7 and 1-12AU7. Features tube shielding, plastic sealed color coded capacitors, smooth acting controls, good filtering, excellent decoupling, low hum and noise level, and all aluminum cabinet. Special balancing control for absolute minimum hum level. Cathode follower, low impedance output circuit for complete installation flexibility.

SPECIFICATIONS:
Provides five switch selected inputs, 3 high level, and two low level, each with individual level controls—4 position LP, RIAA, AES, and early 78 equalization switch—4 position roll-off switch, 8, 12, 16 with one flat position. Separate tone controls, bass 18 db boost and 12 db cut at 50 CPS, treble 15 db boost, and 20 db cut at 15,000 CPS. Power requirements from Heathkit Williamson Type Amplifier power supply 6.3 volts AC at 1 ampere, and 300 volts DC at 10 MA. Over-all dimensions 12⅝" wide x 5⅞" deep x 3⅝" high.

APPLICATION:
The new Heathkit WA-P2 Preamplifier has been designed to operate with any of the Heathkit Williamson Type Amplifiers and is directly interchangeable with the previous Model WA-P1 Preamplifier unit. Order your kit today and enjoy completely smooth control over the operation of your Hi-Fi system. Obtain the exact tonal balance of bass and treble with the precise degree of equalization you want. Note that the design of the WA-P2 accommodates the newly established RIAA curve.

MODEL WA-P2
$19.75
Shpg. Wt. 7 lbs.

HAM EQUIPMENT


Single knob band switching—pre-wound coils.
Crystal or VFO excitation—metered operation.
52 ohm coaxial output—built-in power supply.

Heathkit
AMATEUR
TRANSMITTER KIT

The Heathkit AT-1 Transmitter has established a high reputation and has been enthusiastically accepted by hundreds of experienced operators as well as beginners. Power input up to 35 watts for the novice and suitable as a standby exciter for your higher powered rig later on.

Model AT-1 can be crystal or VFO excited and operates on 80, 40, 20, 15, 11 and 10 meters. The prewound coils with the oscillator and amplifier are switched simultaneously by the rugged band switch. Meter switch allows a reading of the final grid and plate current on the panel mounted meter. Modulator input and VFO power sockets are provided as well as a key jack for CW operation. Other features include a crystal socket, standby switch, key click filter, AC line filter, good shielding and a 52 ohm coaxial output. The 425 volt, 100 milliampere power supply and 5U4 rectifier are more than adequate for the 6AG7 oscillator multiplier and 6L6 amplifier doubler.

MODEL AT-1
$29.50
Shpg. Wt. 16 lbs.

Copper plated chassis—aluminum cabinet—easy to build.
Smooth acting illuminated and precalibrated dial.
Seven band coverage 160 through 10 meters at 10 volt RF output.
6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.

Brand NEW
HEATHKIT
VFO KIT

The new Heathkit VFO is the perfect companion to the Heathkit Model AT-1 Transmitter and it has sufficient output to drive any multi-stage transmitter of modern design. Good mechanical and electrical design insures operating stability. Coils are wound on stable, heavy duty, ceramic forms using Litz or double cellulose wire coated with Polystyrene cement and baked for humidity protection. Variable capacitor of differential type construction, especially designed for maximum bandspread. Kit is furnished with a carefully precalibrated scale which provides well over two feet of scale length. Smooth acting vernier reduction drive and illuminated dial provides easy tuning and zero beating.

Power requirements 6.3 volts AC at .45 amperes, and 250 volts DC at 15 mils. Just plug it into the power receptacle provided on the rear of the AT-1 Transmitter. Seven band coverage 160 through 10 meters with 10 volt average RF output. Uses 6AU6 electron coupled Clapp oscillator and OA2 voltage regulator.

MODEL VF-1
$19.50
Shpg. Wt. 7 lbs.

Heathkit
GRID DIP METER KIT

The invaluable instrument for Hams, servicemen and experimenters. Useful in TV service work, for alignment of traps, filters, IF stages, peaking compensation networks, etc. Locates spurious oscillation, provides a relative indication of power in transmitter stages. Use it for neutralization, locating parasitics, correcting TVI, measuring CL and Q of components, and determining RF circuit resonant frequencies. The variable meter sensitivity control, headphone jack, 500 microampere Simpson meter, continuous frequency coverage from 2 MC to 250 MC. Prewound coil kit and rack included.

LOW FREQUENCY COILS:
Low frequency range extended to 355 KC by the use of two additional coils. Complete with dial correlation curves. Set 341-A for GD-1B and set 341 for GD-1A. Shipg. wt. 1 lb. Price $3.00

MODEL GD-1B
$19.50
Shpg. Wt. 4 lbs.

Heathkit ANTENNA
IMPEDANCE METER KIT

MODEL AM-1
$14.50
Shpg. Wt. 2 lbs.

Determine antenna resonance and resistance, transmission line surge impedance, and receiver input impedance. Works with one-half and one-quarter wave lines, half wave and folded dipoles, harmonic mobile and beam antennas. Resistance type SWR bridge —100 microampere meter—frequency range 0-150 MC—impedance range 0-600 ohms.

MODEL AC-1
$14.50
Shpg. Wt. 4 lbs.

Heathkit
ANTENNA COUPLER KIT

For the Heathkit AT-1 Transmitter or any comparable Amateur Transmitter. Will handle power up to 75 watts at its 52 ohm coaxial input. Matches a wide range of antenna impedances with its L type tuning network and neon indicator. A tapped inductance provides coarse adjustment and a transmitting type variable condenser sets it "right on the nose." Will operate on the 10 through 80 meter bands.

HEATH company
BENTON HARBOR 15,
MICHIGAN

New LOW PRICED
HEATHKIT SINGLE UNIT
Williamson Type *High* Fidelity
AMPLIFIER KIT

Rugged, heavy duty, single chassis construction.
Standard brand components used, no sacrifice of quality.
Output impedances 4, 8, and 16 ohms.

Send for free booklet "High Fidelity Especially For You."

Lowest price high quality Williamson Type Amplifier ever offered.

Here is the newest Heathkit Hi-Fi Amplifier at the lowest price ever quoted for a complete Williamson Type Amplifier circuit. The W-4 Model has been designed for single chassis construction, and only for the new Chicago Transformer Company Model BO-13 "super range" high fidelity output transformer. This transformer, a new development in the Hi-Fi field, is being offered at substantial saving over transformers of comparable quality. It is outstanding in performance and on the basis of our tests, we find it equal in every respect to transformers used in the W-2 and W-3 Heathkit series.

LOW PRICES:
Through utilization of a single chassis with resultant economy obtained through elimination of duplicate sheet metal fabrication, connecting cables, plugs, sockets, and a new Chicago "super range" output transformer, a 20% price reduction has been made possible without sacrificing kit quality.

COMPONENTS:
The new Heathkit W-4 uses the same heavy duty power transformer and choke. It has all of the features of previous models including individual jacks and a wire wound control to balance the output tubes—plastic high quality capacitors and the exact circuitry previously utilized in Williamson Type Amplifiers. Intermodulation distortion and harmonic distortion are both at the same low level as in the W-2 and W-3 models.

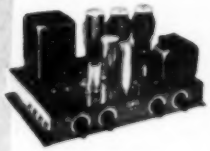
CONSTRUCTION:
Here is the opportunity for even the economy minded Hi-Fi enthusiast to enjoy all of the advantages offered through Hi-Fi reproduction of fine recorded music. Simplified step-by-step Construction Manual completely eliminates necessity of electronic knowledge or special equipment. Assemble this Amplifier in a few pleasant hours.

COMBINATIONS AVAILABLE

W-4M with Chicago "super-range" transformer only. Single chassis main amplifier and power supply. Shipping weight 28 lbs. Express only **$39.75**

COMBINATION W-4 with Chicago "super-range" transformer only includes single chassis main amplifier and power supply with WA-P2 preamplifier kit. Shpg wt. 35 lbs. Express only **$59.50**

NEW *Heathkit* 20 WATT
High Fidelity AMPLIFIER KIT



MODEL A-9B

$35.50

Shpg. Wt. 24 lbs.

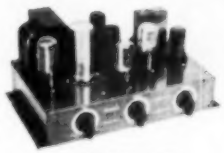
In keeping with the progressive policy of the Heath Company, further improvement has been made in the already famous Heathkit High Fidelity 20 Watt Amplifier. Additional reserve power has been obtained by using a heavier power transformer. A new output transformer designed and manufactured especially for the Heath Company, now provides output impedances of 4, 8, 16 and 500 ohms. The harmonic distortion level will not exceed 1% at the rated output.

FEATURES:
Outstanding features of the Heathkit 20 watt Amplifier include frequency response of ±1 db from 20 CPS to 20 KC. Separate (boost and cut) bass and treble tone controls. Four switch selected input jacks and a special hum balancing control. Flexibility is emphasized in the input circuits and proper equalization for all input devices is incorporated.

TUBE LINEUP:
12AX7 magnetic preamplifier and first audio amplifier. 12AU7 two stage amplifier with tone controls. 12AU7 voltage amplifier and phase splitter. Two 6L6 push-pull beam power output and 5U4G rectifier.

The Heathkit Model A-9B is excellent for custom installation and is designed for outstanding service at a very reasonable cost.

Heathkit SIX WATT
AMPLIFIER KIT



MODEL A-7B

$15.50

Shpg. Wt. 10 lbs.

An outstanding value, this economically priced 5 watt Amplifier is capable of performance expected only in much more expensive units. Only 2 or 3 watts output will ever be used in normal home applications and Model A-7B will be more than adequate for this purpose.

SPECIFICATIONS:
Two switch selected inputs are available for crystal and ceramic phono pickups, tuner, TV audio, tape recorder, and carbon type microphone. Model A-7B features separate bass and treble tone controls, push-pull balanced output stages, output impedances of 4, 8, and 15 ohms, and extremely wide frequency range ±1½ db from 20 CPS to 20 KC. Not just a souped up AC-DC job. Full wave rectification, transformer operated power supply and good filtering, result in exceptionally low hum level.

MODEL A-7C
Provides a preamplifier stage and proper compensation for the variable reluctance cartridge and low level microphone. $17.50

Heathkit
WILLIAMSON TYPE
AMPLIFIER KIT

Here is the famous kit form Williamson Type *high fidelity* Amplifier that has deservedly earned highest praise from every strata of Hi-Fi music lovers. Virtually distortionless, clean musical reproduction, full range frequency response, and more than adequate power reserve.

OUTPUT TRANSFORMERS:
This outstanding Williamson Type Hi-Fidelity Amplifier is supplied with the famous Acrosound TO-300 output transformer. This quality transformer features the popular "ultra-linear" output circuit for clean maximum power level. Separate chassis for amplifier and power supply.

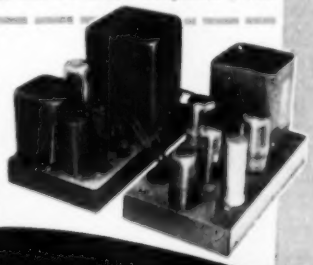
SPECIFICATIONS:
Frequency response within 1 db from 10 cycles to 100,000 cycles. Harmonic distortion at 5 watt output less than .5% between 20 cycles and 20,000 cycles. IM distortion at 5 watts equivalent output .5% using 60 and 3,000 cycles. Output impedances of 4, 8, or 16 ohms. Overall dimensions for each unit 7" high x 5½" wide x 11½" long.

CONSTRUCTION MANUAL:
This fine kit is supplied with a completely detailed step-by-step Construction Manual and the only effort required is the assembly and wiring of the pre-engineered kit. Even the complete novice can successfully construct this Amplifier and have fun building it.

COMBINATIONS AVAILABLE:

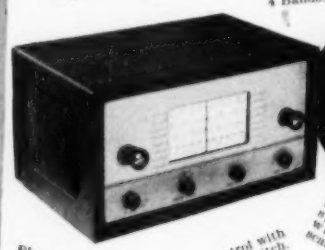
W-3 Amplifier Kit (Includes Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P2 Preamplifier.) Shipping weight 37 lbs. Shipped express only..... **$69.50**

W-3M Amplifier Kit (Includes Main Amplifier with Acrosound Output Transformer and Power Supply.) Shipping weight 29 lbs. Express only **$49.75**



HEATH company
BENTON HARBOR 15,
MICHIGAN

Heathkit COMMUNICATIONS RECEIVER KIT


Separate BFO oscillator tube and circuit.
Continuous coverage 550 KC—35 MC on 4 Bands.
MODEL AR-2
$25.50
(Less Cabinet)
Shpg. Wt. 12 lbs.
Phone—standby—CW panel switch.
RF gain control with AGC on-off switch.
Electrical band-spread tuning with logging scales.

An excellent example of typical Heath Company ability to produce top quality kit merchandise at ridiculously low prices, is the AR-2 Communications Receiver. Here is a transformer operated all-wave receiver with all of the desired features and none of the disadvantages commonly encountered in so-called "economy sets."

Receiver employs high gain miniature tubes and IF transformers, chassis mounted 5½" PM speaker, headphone jack, slide rule dial with Ham Bands plainly identified, and easy tuning with direct planetary drive. Continuous frequency coverage from 550 KC to 35 MC on 4 Bands, with electrical bandspread tuning and logging scales. Other features are RF gain control with AGC on-off switch-phone-standby-CW panel switch—prewound coils in a shielded turret assembly and copper plated chassis and shielding.

Uses 12BE6 mixer-oscillator, 12BA6 IF amplifier, 12AV6 detector-first audio, 12A6 beam power output, 12BA6 BFO oscillator, and 5Y3 rectifier. A lettered control plate is provided for the cabinet of your choice or you can order the optional Heathkit cabinet featuring the full size aluminum panel.

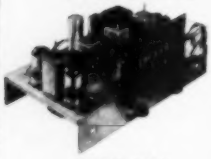
RECEIVER CABINETS

Proxylin impregnated fabric covered plywood cabinet available for BR-2 and AR-2 receivers. Includes aluminum panel, flocked reinforced speaker grill and protective rubber feet.

For BR-2 Receiver, Cabinet 91-9
Shipping weight 5 lbs. $4.50

AR-2 Receiver, Cabinet 91-10
Shipping weight 5 lbs. $4.50

Heathkit FM TUNER KIT



MODEL FM-2

$22.50

Shpg. Wt. 8 lbs.

Here is an FM Tuner that can be operated with your Hi-Fi Amplifier or through the "phono" section of the ordinary radio. Completely AC operated to eliminate problems usually encountered in "economy type" AC-DC tuner circuits. Features 8 tube circuit with separate mixer and oscillator, 3 double tuned IF stages followed by a limiter discriminator providing maximum sensitivity and selectivity across the full FM frequency band of 88 MC to 108 MC. The tuning unit is factory assembled and adjusted, thus eliminating tedious critical "front end" alignment problems. The attractive slide rule dial and vernier tuning combine to make the Heathkit FM-2 Tuner simple to operate.

Heathkit BROADCAST BAND RECEIVER KIT

MODEL BR-2

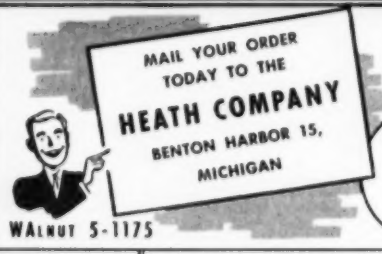
$17.50

(Less Cabinet)

Shpg. Wt. 10 lbs.

The Model BR-2 Broadcast Band Receiver is designed especially for the beginner without any sacrifice of quality. This receiver features a transformer operated power supply, high gain miniature tubes, sharply tuned IF transformers, new rod type built-in antenna, and a trouble-free planetary tuning system. Exceptional performance with unusually high sensitivity, good selectivity, and excellent tone quality from the 5½" PM chassis mounted speaker. Can be used either as a receiver, tuner, or phono amplifier. Uses 12BE6 mixer-oscillator, 12BA6 IF amplifier, 12AV6 detector, 12A6 beam power output, and 5Y3 rectifier.

HEATH COMPANY · Benton Harbor 15, Mich.



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- ☐ Freight
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QUANTITY	ITEM	MODEL NO.	PRICE

Enclosed find ( ) check ( ) money order for
Please ship C.O.D. ( ) postage enclosed for _____ pounds.

On Express orders do not include transportation charges—they will be collected by the express agency at time of delivery.

ON PARCEL POST ORDERS insure postage for weight shown.

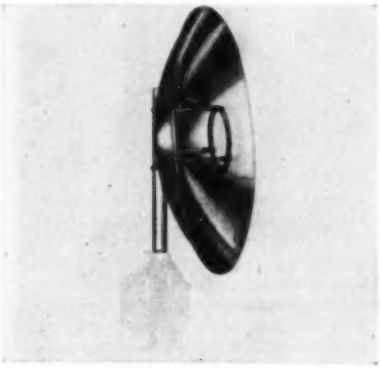
ORDERS FROM CANADA and APO's must include full remittance.

NEW TV PRODUCTS on the Market

PARABOLIC U.H.F. ANTENNA

FKB Opticon Company, Inc., 1738 E. Calvert St., South Bend 14, Ind., is now offering a new lightweight parabolic type u.h.f. antenna. Of spun aluminum, the new unit weights 2¼ pounds.

According to the company the gain is higher for top fringe area reception



without sacrificing the "ghost" elimination properties for close-in performance.

Assembly and installation of the "Opticon" are simple and highly practical from both sales and service standpoints, and provide a perfect match for 300-ohm line. A data sheet on this new antenna is available from the company on request.

"TV DYNATRACER"

Century Electronics Co., 211-04 99th Ave., Queens Village 29, N. Y., is now offering a compact test unit which will act as a signal tracer, voltage tracer, and component checker.

The "TV Dynatracer" can be used to check such service faults as no sound-no picture, no sound-good picture, no picture-good sound, no vertical sweep, no horizontal sweep, loss of vertical sync, loss of horizontal sweep, and loss of both horizontal and vertical sync.

The "Dynatracer" is self-contained and operates independently.

COIN TIMER DEVICE

Master Electronics & Television, Route 1, Box 36, Libertyville, Ill., is in production on an automatic coin timer device, the "Entiser."

Designed to be used with coin-operated TV sets, the device is readily adaptable to other coin-operated units such as radios, juke boxes, etc. The "Entiser" is a timer circuit which automatically turns on a TV set every hour and half-hour for a free 4-minute operating period, on a preset operating schedule. This operation attracts attention to itself, lighting an illuminated sign which explains the action taking place to the viewer and thereby arousing viewing interest and encouraging the viewer to deposit the proper coin for continued operation of the set.

The device combines, within itself, a coin-meter mechanism, the entire assembly being contained in a metal case approximately the size of an a.c.-d.c. receiver. Provision is made in the top of the case for the insertion of artificial flowers or vines so as to provide a decorative effect atop the TV set. The device requires no TV circuitry changes, no undue cabinet drilling or drastic alterations.

The product is being handled by *Fellcisen Associates* of 5839 W. Montrose Ave. in Chicago.

TV ANTENNA TOWER

Rohn Manufacturing Company, 116 Limestone, Bellevue, Peoria, Illinois, is now in production on a new tower which is suitable for home TV installations and other communications requirements.

The No. 6 tower is self-supporting to 50 feet heights or guyed to 150 feet. It features a 12½" triangular design with heavy-duty corrugated cross bracing. The tower is designed to fill 75 per-cent of all tower needs, thus reducing the dealer's requirement for high inventories.

Full information on this new tower is available from the company or its sales representatives.

BOOSTER OR CONVERTER

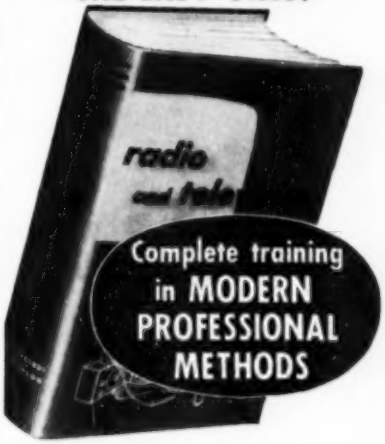
Fenton Company, 15 Moore Street, New York 4, N.Y., is offering a uniquely designed booster or u.h.f. converter that is designed to be seen.

The unit can be used as an illuminated plant vase, as a lighted aquarium,

or as a television lamp in addition to its function as either a converter or booster.

Handle *Tough* Service Jobs

AS "SLICK" AS YOU DO THE EASY ONES!



FIX *ANY* RADIO OR TV SET EVER MADE...

Easier . . . Better . . . Faster

How to trouble-shoot the professional way

AM, FM and TV realignment made easy

Testing tips and ideas

A complete guide to TV service

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Special problems in battery sets, communications receivers, recorders, etc.

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. . . and dozens of other subjects

Owning this big, up-to-the-minute book is like having two of the world's greatest electronic experts standing by your side on every job . . . telling you just what to do, exactly how to do it!

Written by Ghirardi and Johnson, Radio & Television TROUBLESHOOTING AND REPAIR is a complete guide to modern **professional** methods . . . the kind that really pay off big. Step by step, it takes you through service procedures . . . from locating troubles fast and with less testing to making repairs accurately and promptly.

For **beginners**, this giant book is a complete service training course . . . at only a fraction of the price you might expect. For **experienced servicemen**, it is the ideal way to "brush up" on specific jobs; to develop better methods and shortcuts; and to find quick answers to problems that will enable you to handle tough jobs as fast and accurately as you now handle the easy ones.

Contains 820 big pages. Over 400 clear pictures, diagrams and charts make things doubly clear.

Remember! More men now in good servicing jobs got their training from Ghirardi books than any others of their type . . . **and this new book is the latest and greatest of them all!** Practice from it for 10 full days **AT OUR RISK!**

EXAMINE IT FREE!

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232 Madison Ave., New York 16, N. Y.

Send Ghirardi's new Radio & TV TROUBLE-SHOOTING AND REPAIR book for 10-day FREE EXAMINATION. If I decide to keep book, I will then promptly remit $6.75 (plus a few cents postage) in full payment. If not, I will return book postpaid and owe you nothing.

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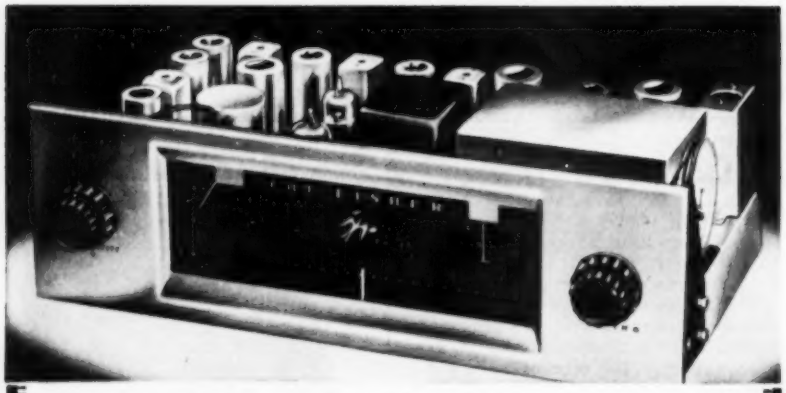
OUTSIDE U.S.A.—Price $7.25 cash with order. Money back if book is returned within 10 days.



It's New! It's Terrific!

THE FISHER

FM TUNER

MODEL FM-80

NEVER before in the history of Frequency Modulation has there been a tuner to match the remarkable, new FISHER FM-80. Equipped with TWO meters, it will outperform any existing FM tuner, *regardless of price!* The FM-80 combines extreme sensitivity, flexibility, and micro-accurate tuning. It has an unusually *compact,* beautifully designed chassis. Like its renowned companions, the FISHER FM-AM Tuners, Models 50-R and 70-RT, we predict the FM-80 will be widely imitated, but never equalled. Be sure; buy THE FISHER. **Only $139.50**

Outstanding Features of THE FISHER FM-80

● TWO meters; one to indicate sensitivity, one to indicate center-of-channel for micro-accurate tuning. ● Armstrong system, with two IF stages, dual limiters and a cascode RF stage. ● Full limiting even on signals as weak as one microvolt. ● Dual antenna inputs: 72 ohms and 300 ohms balanced. ● Sensitivity: 1½ microvolts for 20 db of quieting on 72-ohm antenna input; 3 microvolts for 20 db of quieting on 300-ohm antenna input. ● Chassis *completely* shielded and shock-mounted, with full shielding of tuning condenser to eliminate microphonics, and noise from otherwise accumulated dust. ● Three controls — Variable AFC/Line-Switch, Sensitivity, and Station Selector PLUS an exclusive Output Level Control. ● Two bridged outputs; low-impedance, cathode-follower type, permitting output leads up to 200 feet. ● 11 tubes. ● Dipole antenna supplied. Beautiful, brushed-brass front panel. ● Self-powered. ● WGT: 15 pounds. ● SIZE: 12¾" wide, 4" high, 8⅛" deep including control knobs.

Price Slightly Higher West of the Rockies

WRITE TODAY FOR COMPLETE SPECIFICATIONS

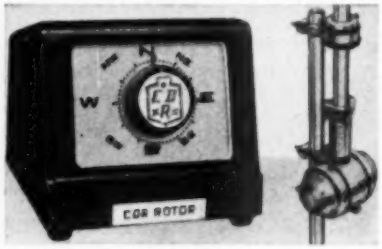
FISHER RADIO CORP. · 21-23 44th DRIVE · L. I. CITY 1, N. Y.

The u.h.f. converter, Model C-1, covers all channels from 14 to 83. The v.h.f. booster, Model B-1, covers channels 2 through 13. Both models have good frequency stability, optimum selectivity for sharpest picture reception, low noise figures, careful shielding against external radiation or outside noise pickup.

AUTOMATIC ROTOR

Radiart Corporation of Cleveland 13, Ohio, has added a new, completely automatic rotor to its line of *CDR* antenna units.

Housed in a modern-design plastic



cabinet which uses 4-wire cable, the new unit is available in two models. The AR-2 includes a thrust bearing while the AR-1 is for ordinary installations without a thrust bearing.

Other features include a mechanical brake that is released magnetically, a quick-mounting antenna mast collet, speedy installation with no loose parts to assemble, minimum wind resistance, and accommodation of antenna masts up to 1½" o.d.

TV PICTURE TUBES

The TV Picture Tube Division of *Sylvania Electric Products Inc.*, Seneca Falls, N. Y., has added two new aluminized picture tubes, a 17" and a 27", to its line.

The Type 17QP4A is all glass, rectangular, and contains a gray filter cylindrical face with aluminized screen for optimum picture contrast and brightness. It is magnetically deflected and focused for use with a single field ion trap and is supplied with an external conductive coating.

The Type 27SP4 is physically the same as the 17" tube but is electrostatically focused, magnetically deflected for use with a single-field ion trap. It is also supplied with an external conductive coating. The deflection angle is 90 degrees.

COMMUNITY TV UNITS

The Engineering Products Division of *Radio Corporation of America,* Camden, N. J., is now marketing five new electronic accessories that are designed to increase and improve the service of community television systems, both large and small.

Included is a converter for transmitting u.h.f. signals over v.h.f. channels. Other accessories include a broadband sweep converter for alignment operations; a low-noise preamplifier for stepping up weak v.h.f. signals; an "*Antenaplex*" v.h.f. crossover network for mixing and dividing low- and high-band v.h.f. signals; and a line voltage regu-

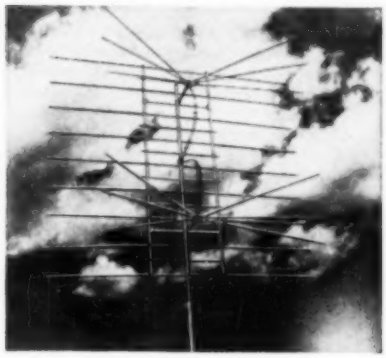
lator for regulating the a.c. line voltage.

Individual brochures detailing the features and applications of each of the five new accessories are available on request from the division.

"KING PIN" ANTENNA

Telrex, Inc., of Asbury Park, N. J., has recently released its "King Pin," 2-bay conical "V" beam screen array to the trade.

The antenna exhibits a measured gain on the low v.h.f. channels of 7½



to 8½ db and 15 to 17 db on the upper v.h.f. channels. Good performance is also obtained on u.h.f. without modification, according to the company.

Use of the conical "V" beam dipoles provides uniform match to standard 300 ohm line or 200 ohm low-loss line over the entire operating band. The "V" beam action against the non-frequency sensitive screen reflector provides a compact, in-line, single-lobed directional pattern in both the horizontal and vertical planes on all frequencies.

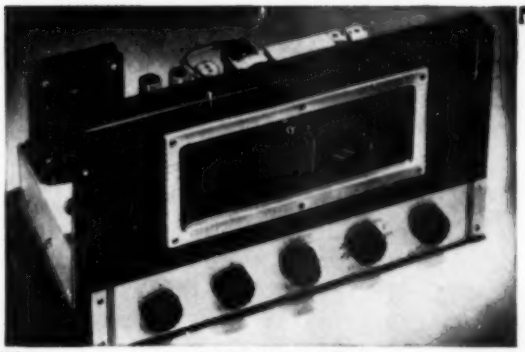
DISTRIBUTION AMPLIFIERS

A new line of distribution amplifiers designed to prevent line loss in master TV systems has been announced by *Davis Electronics* of 4002 Burbank Blvd., Burbank, California.

The new model features complete electronic isolation of each output. This is accomplished electronically with separate triode amplifiers, giving 40 db isolation between outputs. No isolation resistors are used. It is equipped with a built-in mixer stage for fully integrated performance. No separate

mixer is required for either a single all-channel v.h.f. antenna or separate high- and low-channel antennas.

Three versions of this unit are cur-



MODEL 70-RT

Top Two

FM-AM TUNERS

FISHER

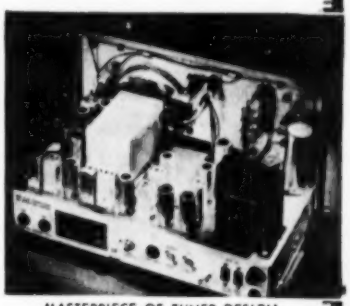
Professional

FM-AM TUNERS

THE truest index to the quality of FISHER Tuners is the roster of its exacting users. An Eastern FM station uses the FISHER to pick up selected New York and Washington programs *direct*, for rebroadcast to its own community. Reception of FM stations over 150 miles distant, terrain permitting, is a regular occurrence, if you own a FISHER Professional FM-AM Tuner.

MODEL 70-RT

■ Features *extreme sensitivity* (1.5 mv for 20 db of quieting); works where others fail. Armstrong system, *adjustable* AFC on switch, *adjustable* AM selectivity, separate FM and AM front ends. Complete shielding and shock-mounting on main *and* subchassis. Distortion below 0.04% for 1 volt output. Hum level: better than 90 db below 2 volts output on radio, better than 62 db below output with 10 mv input on phono. Two inputs. Two cathode follower outputs. Self-powered. Exceptional phono preamplifier with enough gain for even lowest-level magnetic pickup. Full, phono equalization facilities. 15 tubes. Six controls, including Bass, Treble, Volume, Channel/Phono-Equalization, Tuning and Loudness Balance. Beautiful Control Panel. SIZE: 14¾" wide, 8½" high, 9¼" deep.



MASTERPIECE OF TUNER DESIGN

MODEL 50-R

■ Identical to the 70-RT but designed for use with an *external* preamplifier-equalizer, such as the FISHER Series 50-C.

MODEL 50-R

MODEL 70-RT
$184.50

MODEL 50-R
$164.50

PRICES SLIGHTLY HIGHER WEST OF THE ROCKIES

Write for Full Details

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WE ARE PROUD TO ANNOUNCE THE

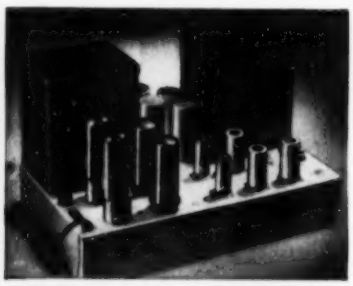
Greatest Advance

IN AMPLIFIER DESIGN
IN TWENTY YEARS!

FISHER

Z-MATIC PAT. PEND.

THE unusual, the choice—both are a regular and traditional product of our engineering laboratories. But never before have we offered a technological advance so obviously needed, so long overdue, as the exclusive FISHER Z-Matic. Regardless of the speaker system, be it a modest 8" unit or a giant assembly, the vast acoustic improvement contributed by FISHER Z-Matic is instantly apparent and truly astonishing. For Z-Matic has at one stroke eliminated the energy-wasting, distortion-producing mismatch that has prevented the *complete* union of speaker and amplifier ever since the advent of electronic sound reproduction. Z-Matic is now standard equipment on all FISHER amplifiers.



What Z-Matic Does

- Multiplies the efficiency and effective audible range of *any* speaker system, regardless of size.
- The continuously variable Z-Matic control permits any setting, according to personal taste or the requirements of the speaker system.
- Eliminates need for oversize speaker enclosures and *automatically* corrects inherent deficiencies in speaker or speaker housing.
- Z-Matic must *not* be confused with tone, equalization or loudness balance controls.

50-Watt Amplifier · Model 50-AZ

100 watts peak! World's finest all-triode amplifier. Uniform within 1 db, 5 to 100,000 cycles. Less than 1% distortion at 50 watts. Hum and noise 96 db below full output. Oversize, quality components and finest workmanship. $159.50

A Word to Our Patrons

Your FISHER 50-A or 70-A amplifier can be readily equipped with Z-Matic. A complete kit of parts and easy-to-follow instructions are available at a cost of only $2.50 to cover handling. Give serial number and model.

Master Audio Control · Series 50-C

"Finest unit yet offered." — *Radio and TV News.* 25 choices of record equalization, separate bass and treble tone controls, loudness balance control. 5 inputs *and* 5 independent input level controls, two cathode follower outputs.

Chassis, $89.50 • *With cabinet,* $97.50

25-Watt Amplifier · Model 70-AZ

50-watts peak! More *clean* watts per dollar. Less than ½% distortion at 25 watts (0.05% at 10 watts.) Response within 0.1 db, 20-20,000 cycles; 1 db, 10 to 50,000 cycles. Hum and noise virtually non-measurable! $99.50

Prices Slightly Higher West of the Rockies

WRITE TODAY FOR COMPLETE SPECIFICATIONS

FISHER RADIO CORP. · 21-23 44th DRIVE · L. I. CITY 1, N. Y.

rently available, the Model DA-2 with two outputs rated at 30 watts; the DA-4 with four outputs and rated at 35 watts, and the Model DA-8 rated at 45 watts and having 8 outputs.

PICTURE TUBE TESTER

A new picture tube and TV receiver tester that dynamically tests all magnetically deflected black-and-white or color tubes under actual receiving conditions has been announced by *Boland & Boyce, Inc.,* 236 Washington Ave., Belleville 9, N. J.

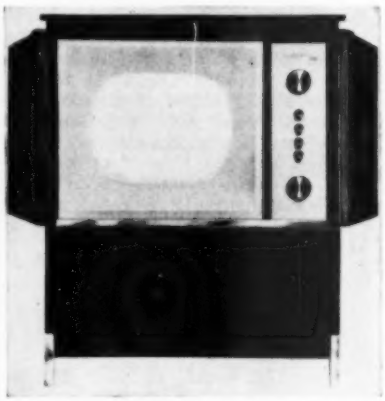
The Model 701 is available in either kit or factory wired form. The complete assembly, including a 4½", 100 μa. *Simpson* meter, is housed in a sturdy steel carrying case which measures 9" high by 6" wide by 5" deep.

All connecting cables and an illustrated instruction manual are furnished with the unit. The kits include complete and detailed construction information.

CBS COLOR RECEIVER

CBS-Columbia is in production on a new color television receiver which incorporates the firm's "Colortron 205" tube.

The set will be available as a full-door console or as an open-face model.



The 44-tube chassis incorporates the "360" sound system. The picture produced is closest in size to the standard 21" black-and-white tube. The receiver has louvered sides, brass-tipped legs, and a simple frame. A big-screen table model will also be offered.

FRINGE AREA ANTENNAS

Ward Products Corporation of Cleveland and Ashtabula, Ohio, has recently introduced three "fringe area" antennas to the trade.

The "Fringemaster" is available in single and stacked models and features a trap bolt type of fold-up construction which prevents antenna collapse and forms a more rigid and permanent assembly. The three models are the single bay TV-285, the quarter-wave stack TVS-286, and the half-wave stack TVS-287. Stacking kits are available as TVS-288 and TVS-289.

ANTENNA ROTATOR

Leader Electronics, Inc., of Cleveland, Ohio, has introduced a new, low-

er-priced antenna rotator plus an improved, newly-designed control unit to the trade.

The rotator, Model M-500, features high torque output and rugged construction which permit the handling of large arrays with peak performance. Construction features a no-drift, no-coast, cut steel worm gear drive; oil-impregnated cast bronze bearings; and pre-assembled hardware.

The control unit has an automatically illuminated dial. The cabinet is of ultra-modern design and is available in mahogany or blonde finishes.

This control box can be used with both the Model M-500 rotator and the company's improved, deluxe Model M-100 rotator which was formerly marketed as the Model SH. —30—

PRINTED CIRCUIT TV

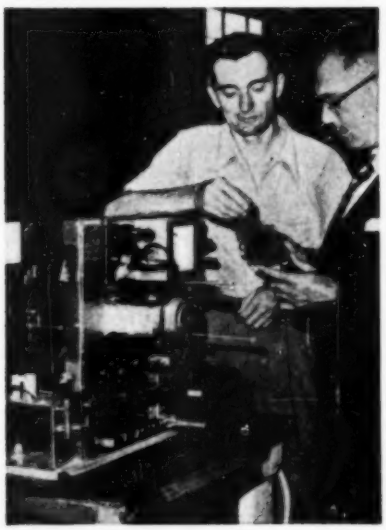
WALSCO ELECTRONICS CORPORATION is now offering a printed circuit television chassis, the PC-9. The set uses nine circuit units printed on plastic which reduces the usual 2900 hand-soldered connections to 56. Each of the nine circuit strips plugs into the vertically mounted chassis. Any of the components can be reached for servicing without removing the chassis from the cabinet.

Another feature of the new chassis is the completely automatic remote control unit which is standard equipment with this model. It is a motor-driven unit that automatically finds the channel and automatically locks in the best balanced picture and sound. The unit itself is only slightly larger than a package of cigarettes and can be used up to 20 feet away from the set.

The new chassis will accommodate 21", 24", or 27" tubes with 90 degree deflection. The chassis comes complete with the remote control and a tube mounting kit.

The company, at 3225 Exposition Pl., Los Angeles, California, will provide additional details on request. —30—

A circuit strip from the new Walsco PC-9 television chassis is checked by engineer Fred Miller, left, and Walter L. Schott, president of Walsco Electronics Corp.



Fine Additions

TO COMPLETE YOUR HOME MUSIC SYSTEM

FISHER

ACCESSORIES

MIXER-FADER · Model 50-M

NEW! Electronic mixing or fading of any two signal sources (such as microphone, phono, radio, etc.) No insertion loss. Extremely low hum and noise level. High impedance input; cathode follower output. 12AX7 tube. Self-powered. Beautiful plastic cabinet. *Only* **$19.95**

PREAMPLIFIER-EQUALIZER · 50-PR

Professional phono equalization. Separate switches for HF roll-off and LF turn-over; 16 combinations. Handles *any* magnetic cartridge. Extremely low hum. Uniform response, 20 to 20,000 cycles. Two triode stages. Fully shielded. Beautiful cabinet. Self-powered. **$22.95**

HI-LO FILTER SYSTEM · Model 50-F

Electronic, *sharp cut-off* filter system for suppression of turntable rumble, record scratch and high frequency distortion — with *absolute minimum* loss of tonal range. Independent switches for high and low frequency cut-off. Use with any tuner, amplifier, etc. **$29.95**

PREAMPLIFIER · Model PR-5

A self-powered unit of excellent quality, yet moderate cost. Can be used with any low-level magnetic cartridge, or as a microphone preamplifier. Two triode stages. High gain. Exclusive feedback circuit permits long output leads. Fully shielded. Uniform response, 20 to 20,000 cycles. **$12.57**

PROFESSIONAL PHONO CARTRIDGES

America's first *factory-sealed*, moving coil phonograph cartridge. You are the *first* to handle the cartridge you buy. High compliance improves low frequency response, reduces record hiss and wear. Exclusively with diamond stylus. Model 50-LP (33-45) or Model 50-ST (78). *Each* **$37.50**

SPEAKER ENCLOSURE · Series 50-H

Can be used with 12" or 15" single, coaxial, dual or triaxial speaker systems. Its over-all balance is instantly apparent. Smooth response to below 30 cycles. Does *not* require corner placement. Improves any speaker.

Model 50-HM *(Mahogany)* **$114.50**
Model 50-HB *(Blonde)* **$119.50**

Prices Slightly Higher West of the Rockies

WRITE TODAY FOR COMPLETE SPECIFICATIONS

FISHER RADIO CORP. · 21-23 44th DRIVE · L. I. CITY 1, N. Y.

the new HORIZON

so overwhelming you have to hear it!

HORIZON *Criterion*
AM-FM TUNER **$169.95**

HORIZON *20*
20-WATT AMPLIFIER **$84.95**

HORIZON *10*
10-WATT AMPLIFIER **$79.95**

HORIZON *5*
PREAMPLIFIER-CONTROL UNIT **$49.95**

A decibel isn't a drum....

A curve isn't a cello....

A harmonic isn't a harp....

....That's why all the superb statistics we could print (and we've got books full of them!) aren't worth three minutes spent listening to the new HORIZON line of high-fidelity components!

Only a listening test can convey the magic of "Mutamatic" Tuning . . . the distortion-free difference of "Unity-Coupling". . . the velvety silence of hum-free preamplifiers . . . the fabulous flexibility of complete tone control . . . the bedrock stability of National FM!

Furniture by [illegible]
Gown by Cell Chapman

Your National dealer is ready and waiting to give you a startling listening demonstration of the new HORIZON line. Compare it with other lines costing far more. Your ears will prove what an engineer will tell you — *there is no finer high-fidelity system on the market at any price!*

(For those who want them, complete specifications, curves and catalogs are available at your National dealer's.)

tuned to tomorrow

FOR THE NAME OF YOUR NEAREST DEALER OR FOR COMPLETE SPECIFICATIONS WRITE DEPT. R114

National NC

NATIONAL CO., INC., 61 SHERMAN ST., MALDEN 48, MASS.

Now...complete

Protection from the REAR...

with a broad-band antenna that rejects unwanted signals from rear and sides...and

It's another Kay-Townes First!

Mfd. and Distributed in CANADA by DELHI METAL PRODUCTS LTD., DELHI, ONTARIO

the antenna for which all America has been waiting...

this is the PROBLEM

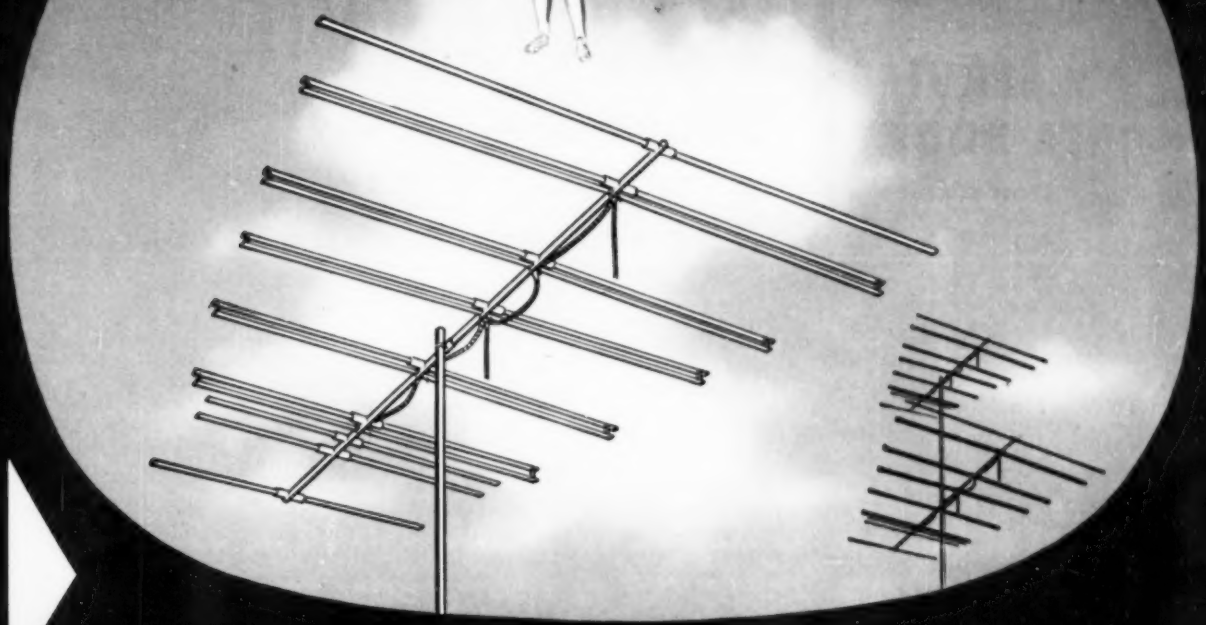
New TV stations by the score *plus* stepped-up power on existing stations is increasing the difficulty of reception in many areas. Co-channel interferences and the resulting loss of reception quality cannot be overcome by ordinary antennas now available.

MODEL	CHANNEL NUMBER
RG-1-L	2-6
RG-1-H	7-13
RG-1-LH (RG-1-L and RG-1-H in combination)	2-13

COPYRIGHT 1954

KAY TOWNES

REAR GUARD

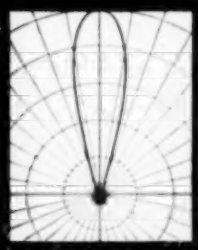


Here is the amazing KAY-TOWNES answer!

Again... KAY-TOWNES is *First* with the answer! The new K-T REAR GUARD completely rejects unwanted signals from the rear and sides to give televiewers the best possible picture and sound reception in areas where co-channel interferences present difficulties. Yes Sir! The new K-T REAR GUARD is ready for you now in arrays to suit your needs . . . It's a Quality Antenna for Quality Reception. It's a Kay-Townes Antenna!

NO interference from the rear

High front to back ratio



RADIATION CURVE
REPRESENTING ALL VHF CHANNELS

Top quality reception

Sharp definition

Primary UHF

WRITE TODAY FOR FURTHER INFORMATION AND PRICES

Use the K-T line of television accessories

KAY-TOWNES

Antenna Company

Box 593A, ROME, GEORGIA

TV SERVICEMEN:
here's the help you need

NEW

"TV SERVICE DATA BOOK"

by **MILTON S. KIVER**

Packed with facts you'll use every single day

GET IT TODAY

all the data you need in one handy guide—

- **saves valuable time**
- **helps you earn more**

Instant TV Servicing and Installation Reference: Have at your finger-tips all of the most frequently needed charts, tables and formulas you require in Television servicing and installation. Includes charts on fuses, color codes, attenuator pads, monochrome signal specifications, guy wire lengths, etc.—all the data you'll ever want in your daily work. Save valuable time on calculations by quick reference to the tables of mathematical constants and electrical formulas. Speeds your work for greater earnings.

Trouble-Shooting Guide: Includes section on TV trouble-shooting. Lists common trouble symptoms and tells how to locate defective components. Recommends most effective methods for use of test probes and other accessory equipment. You'll want to keep it handy in your tube caddy for quick reference at the bench or in the field. It pays for itself in a single day's work. Over 100 pages, 5½ x 8½".

ORDER JB-1.
Only $1.50

ORDER TODAY

HOWARD W. SAMS & CO., INC.

Order from your Parts Jobber today, or write to Howard W. Sams & Co., Inc., 2203 East 46th St., Indianapolis 5, Ind.

My (check) (money order) for $.....
enclosed. Send.....copy (ies) of "TV Service Data Book" (JB-1, $1.50).

Name.....

Address.....

City.....Zone.....State.....
(outside U.S.A. priced slightly higher)

RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

THE title of the keynote address given at the Texas Electronics Association's annual Radio and Television Service Clinic and Electronics Fair held in Dallas, Texas, was, "The future belongs to those who prepare for it." This inspiring talk, delivered by Mr. M. L. Finneburgh, Sr., vice-president and sales manager of the *Finney Company* of Cleveland, Ohio, highlighted a three-day program of lectures and demonstrations that was about equally balanced between discussions of business phases of the service activity and lectures on technical developments.

Reports from service associations in all sections of the country clearly indicate that where service businessmen and technicians are organized they have adopted far-sighted programs for the future. The inconsequential mortality rate among established service businesses during the period of attrition just past indicates that service is in the hands of a solid core of stable service businesses who will provide a dependable foundation for the confidently expected industry expansion in the years immediately ahead.

Nearly five hundred service executives and technicians registered for the association's annual convention. These included shop owners from all sections of the Lone Star State and adjoining states. A significant factor of the Texas meetings was that the business lectures were as well attended as the technical demonstrations. Seasoned observers have noted a gradual shifting of interest among service business operators from merely "how to repair television sets" to "how do you make a living out of a service business."

This growing interest in the management factors of an electronic service business is further reflected in the recent action of the Radio Television Guild of Long Island when they set up a committee of members who are either shop owners or self-employed service technicians to handle their newly initiated public relations program.

Guild members who wish to participate in this promotion must meet certain minimum requirements. These requirements specify that the participant must be employed in service work as a full time activity and he must possess a good reputation for the quality of his work and the character of his business operational plan. Shops that offer "free service," "free estimates," or other known "bait" in advertising to attract customers will not be eligible to participate in the program.

Committee Objectives

The goal of the RTG business group committee is to accomplish the following objectives:

1. Institution of a public relations program. Using a campaign of cooperative advertising, the copy will be prepared by a public relations specialist with ad placement handled by a competent advertising agency. One feature of this program will be to effect a tie-in between the Guild emblem and that of ARTSNY so that members of both groups can benefit from their combined promotional programs.

2. Guarantee each member's work. Under the plan now being considered customer complaints would be referred to the Guild by the Better Business Bureau, the local Chambers of Commerce, or directly to the Guild, as encouraged by the advertising copy.

3. Consideration will be given to a plan for licensing of Guild members who meet the minimum requirements, as established by a special committee. Through publicity given the Guild license it is felt that public acceptance of electronic servicing as a professional activity can be gained.

4. The committee will work with local Better Business Bureaus and Chambers of Commerce to encourage them to refer all complaints about service to the Guild.

5. A plan will be developed to interest local banks in handling time payment repair contracts for Guild members.

6. The development of a standard invoice for customer billing. This would include standardization of shop operations on television receivers so the services performed could be checked on the invoices. It is felt that in establishing standard service operations and their associated charges the set owning public will be given a definite standard of

Here's your Opportunity

to prepare for a good job or a business of your own in TV SERVICING

ARE YOU SATISFIED with the position you now hold? Do you feel you're worth more money? Are you pleased with yourself, your work, your associates . . . and your future? What does the next year hold for you . . . and the year after that?

Are you content merely to plod along through the best years of your life . . . or do you want to get into more pleasant work . . . hold a well-paid job . . . perhaps establish your own business?

If you are looking for a REAL opportunity . . . If you want to GROW with a GROWING INDUSTRY . . . If you want to grasp the success that should be yours, *then we say to you, study TV Servicing.*

Everyone knows that Television is the fastest growing industry today. Opportunities are going begging for men who have the training and ability to grasp them. *Now is the time to start on the road to success in TV Servicing.*

Study at Home in your spare time

The RCA Institutes Home Study Course in TV Servicing is easy to learn. You progress rapidly, step by step, as you learn the procedure of servicing and trouble-shooting TV receivers and installing TV antennas. Hundreds of pictures and diagrams help you understand the how-it-works information and the how-to-do-it techniques.

A Service of Radio Corporation of America

The RCA Institutes TV Servicing course was written and planned by instructors with years of specialized experience in training men. You get up-to-the-minute information, too, because you study right at the source of the latest developments in Television. Your lessons are carefully examined and accurately graded by competent teachers who are interested in helping YOU to succeed.

RCA Institutes is licensed by the University of the State of New York . . . an affiliate member of the American Society for Engineering Education . . . approved by leading Radio-TV Service Organizations . . . approved by Veterans Administration.

It costs so little to gain so much

RCA Institutes makes it easy for you to take advantage of the big opportunities in TV Servicing. The cost of the TV Servicing Home Study Course has been cut to a minimum. You pay for the course on a pay-as-you-learn unit lesson basis. *No other home study course in TV Servicing offers so much for so little cost to you.*

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. *Write for free catalog on resident courses.*

SEND FOR FREE BOOKLET—Mail the coupon—today. Get complete information on the RCA INSTITUTES Home Study Course in Television Servicing. Booklet gives you a general outline of the course by units. See how this practical home study course trains you quickly, easily. Mail coupon in envelope or paste on postal card.

MAIL COUPON NOW!

RCA INSTITUTES, INC., Home Study Dept. RNXT
350 West Fourth Street, New York 14, N. Y.

Without obligation on my part, please send me copy of booklet "RCA INSTITUTES Home Study Course in TELEVISION SERVICING." (No salesman will call.)

Name_____
(please print)

Address_____

City_____ Zone____ State_____

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

FOR **Fast Alignment** AND **AGC Troubleshooting**

BOLAND & BOYCE
MODEL 704 BIAS BOX
0-17 volts d-c
Only 2¼" by 2¼" by 4"

Here's the fast, easy way to tackle automatic gain or automatic volume control circuit trouble-shooting and tough re-alignment jobs. The B&B Bias Box supplies steady, accurately adjustable bias voltages from 0 to 17 volts d-c to substitute for the receiver's own AGC circuit. Just clip it to the chassis apron, attach one lead to nearest 6.3 volt heater terminal and the other in place of the usual AGC supply. No external power needed! Includes detailed instructions, all parts, and clips. KIT—Only $9.95. FACTORY WIRED AND TESTED—$12.95.

TEST C-R TUBES AND RECEIVER CIRCUITS

The B&B TV Picture Tube and Receiver Tester connects between C-R Tube and receiver. Measures both C-R tube and receiver performance dynamically in one all-inclusive test. Tells at a glance whether tube or set is at fault.

8-position switch tests: grid-cathode, heater-cathode, and grid-screen leakage; grid-cathode voltages; receiver screen and video output voltages; beam current at *HV anode*; grid control of beam; effect of brightness and contrast controls; and much more.

Separate plug-in power supply available for testing tubes while still in their cartons. Prices include 2 cabled leads and instruction manual. KIT—$29.95. FACTORY WIRED AND TESTED—$39.95.

USE *ONE* HV PROBE *for all meters all ranges!*

This B&B Universal High-Voltage Probe accurately extends the range of *any* VTVM, multimeter, or voltmeter having sensitivities of 10,000 ohms-per-volt or more. Complete with 4 plug-in precision resistors and instructions for matching any meter, any range—10KV, 30KV, 60KV, and many others. With shielded cable and Amphenol connectors. B&B MODEL 702 HV PROBE—$11.95.

At Leading Distributors Everywhere

Write for Brochure Describing All B&B Products

BOLAND & BOYCE, INC.
Dept. RN-114 236 Washington Avenue
Belleville 9, N. J.

comparison for appraising the legitimacy of service charges. Since the automobile servicing industry has educated the public on standard service operations and set labor charges for each of them, the adoption of a similar pattern for television servicing would win public acceptance, in the opinion of committee members.

7. The committee will investigate the feasibility of establishing customer credit clearing bureaus.

8. A group health insurance program to provide members with the rate advantage possible through organization participation will be instituted.

9. The establishment of a weekly service clinic at which the most troublesome service jobs can be analyzed and diagnosed by a group of technicians.

10. To make association awards to the most cooperative manufacturers and distributors.

11. The Business Group will invite manufacturers and distributors to meet with them in a series of discussion clinics which they hope will lead to a better understanding of their common objectives.

NETSDA Incorporates

In a move to expand its programs and activities the National Electronic Technicians and Service Dealers Association recently appointed a committee to draw up the necessary articles of incorporation as a non-profit organization. Officers elected to act during the interim period are Max Liebowitz of New York, president; David Van Nest of Trenton, New Jersey, vice-president; John A. Wheaton, Long Island, New York, secretary; and T. L. Clarkson, of Harrisburg, Pa., treasurer.

Numbering among its member associations service organizations in New York, New Jersey, and Pennsylvania, a plan was proposed at their recent meeting in New York to rotate their meetings between the three states and particularly to hold them in meeting halls of member associations wherever possible. Bert Bregenzer of Pittsburgh was appointed chairman of a committee whose purpose is to develop a plan for closer cooperation between the member groups and to provide the means for a more extensive exchange of ideas.

A NETSDA committee, under the dual chairmanship of Leon Helk, of Carbondale, Pa., and Joseph Forman of Flushing, N. Y., is making a critical study of two of the licensing bills now pending in New York City and Pennsylvania. The committee will present its findings at their scheduled November meeting when it is planned to hold an open forum on the subject of licensing electronic service technicians.

TV Advertising Contract

One of the most ambitious public relations and service selling programs ever initiated by a service association was recently launched by the Television Service Engineers of Kansas City.

The TSE program was developed by

ONLY Grommes HI-FI AMPLIFIERS offers SO MUCH for SO LITTLE

Performance and quality comparable to costlier amplifiers

Model 55-PG **$59.50** net

Sensational new 12 watt successor to the famous Grommes 50-PG series. Advanced design features: 4-position record compensator, rumble switch, loudness switch, feedback phone equalization and cathode coupled calibrated bass and treble controls.

Power output—12 watts; 20 watts peak.
Distortion—1% harmonic and 2% intermodulation at 12 watts.
Frequency response—± .5 DB. 20 to 50,000 CPS.
Power response—± 1. DB. 30 to 20,000 CPS at 10 watts.
Outputs—includes high impedance jack for tape recorder.
Removable etched control panel; many other features.

BIGGEST VALUE IN 10 WATT AMPLIFIERS

GROMMES Model LJ-3 **$42.75** net

New Grommes Model LJ-3 offers the most value in 10 watt amplifiers in the low-priced field. Features 4-position record compensator, 3 inputs, bass and treble controls and increased negative feedback.

Power output—10 watts; 18 watts peak.
Distortion—2% harmonic and 3% intermodulation at 10 watts.
Frequency response—± 1. DB. 20 to 20,000 CPS. 2 AC outlets; fuse; many other features.

See Nearest HI-FI Jobber or Send Coupon

Grommes
DIVISION of PRECISION ELECTRONICS, INC.
9101-Rtj King St., Franklin Park, Ill.

Rush FREE New Bulletin

Name_____
Address_____
City_____ Zone____ State_____

a professional advertising agency engaged by the association during this past summer. The heart of the enlarged program is a 52-week contract with station KMBC-TV which provides for a weekly TSE telecast. The video program will tie in with the association's regular newspaper ad campaign in an all-out effort to acquaint every TV set owner in Kansas City with TSE and what it stands for.

To implement this aggressive promotional program the advertising agency has developed an extensive system of member identification. All vehicles owned or operated by TSE members carry striking "da-glow" signs on the sides and back to directly associate them with the association's program. Similar signs are displayed by members on their store fronts. Ad mats for individual member's use will provide a direct tie-in in their ads in local newspapers and shoppers' guides.

Concrete Results

The Radio and Television Service Association of Greater Atlanta, Inc., was organized by a group of that city's foremost service companies in cooperation with the Better Business Bureau of Atlanta in an effort to bring some measure of order out of the chaos that existed in television servicing in that city. The association's publicity program is comprised of a series of ads that run weekly in Atlanta newspapers and the widespread distribution of the RETMA-BBB consumer booklet on television service.

In its early stages, the newspaper advertisements carried the complete code of ethics to which all members of the association subscribed, along with a complete list of the names, addresses, and telephone numbers of member companies. The ads now feature specific statements about the realities of television servicing and continue to carry complete identifying information about the companies associated in the program. The first in the series stated:

"*This is the first of a series of statements on TV service.* So-called bargains on TV service do not exist! Business costs are the same for all ethical shops. These bargain ads are to gain your attention, *not* save you money. In order for these 'backyard,' so-called service men, to reduce their charges, they *must* sell you parts you do not need and tack on unnecessary shop charges. Members of this association caution set owners to beware of bargain rates. Your set may even be damaged through ignorance or lack of proper service equipment. Remember, the association guarantees work done by its members."

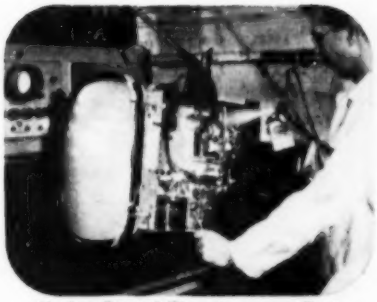
About fifty service dealers are members of the Atlanta association and all report a substantial increase in business since the association's aggressive educational campaign started. All members agree to adhere strictly to the following standards of practice:

(a) Maintain a place of business located in a business section and hold a current business license.

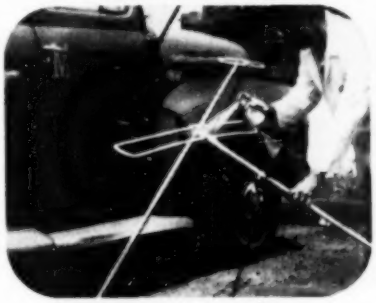
TAKE THE ADVICE OF EXPERTS...

Do a better job
Get a better price
with KRYLON

Spray tube bells with Krylon Crystal-Clear or Flat Black to minimize chance of arcing.



Krylon Crystal-Clear is an excellent dielectric, prevents corona when sprayed on high-voltage connections.



Krylon Bright Aluminum (or Crystal-Clear) prevents corrosion and signal loss.

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New Krylon DULLING SPRAY kills glare and reflections from objects in T-V studio sets. Covers in seconds with fine dull spray that subdues bothersome highlights, simplifies lighting and arranging problems. Easily removed by simply wiping. Krylon Crystal-Clear, and Dulling Spray are available in 12-oz. Spra-tainers. 13 Lustrous Colors available in 6-oz. and 12-oz. Spra-tainers. Order from your T-V Parts Jobber today!

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Designed as a field or laboratory test set for ARC3 radio equipment. Includes CY-146, TS-78, TS-178, J-68, DY-21, DY-22 C-118, CX-214, CS-215, CX-216, MX-173, MX-174, PL-272, U 30 and Relay forming tools. BRAND NEW.

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Although originally designed for testing SCR-522 this set is used for most radio equipment in the freq. range of 100-156 mc. Set contains RF and IF signal generators output meter & power supply, 110V A.C. or batteries. GUARANTEED.

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A compact set for SCR-274N Command equipment and useful for testing airborne radio, A-85, RF noise gen. I-155, I-106, & tool kit. BRAND NEW.

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A precision pulse generator test set producing a marker pulse and synchronizing pulse to calibrate the range on the screen of most RADAR equipment. BRAND NEW.

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(b) Qualified personnel will be used to insure adequate and proper service. A qualified technician is a person who has satisfactorily completed an accredited training course of not less than six months, or an apprentice who has continuously served an apprenticeship under a qualified technician for not less than two years. Under no circumstances will a student be dispatched in answer to a service call when not accompanied by a qualified technician.

(c) Have available and keep in proper operating condition adequate and reliable test equipment to insure a good job. The equipment shall include at least one vacuum-tube voltmeter, one oscilloscope of proper sensitivity, one alignment generator to cover proper frequencies, and one sweep generator of proper width to cover work done.

(d) Maintain an adequate service data library with complete schematic diagrams on makes of sets serviced.

(e) Carry adequate insurance to protect the customer's person and property. Comply with local workmen's compensation, taxation, license laws, etc.

(f) When service contracts are sold, make necessary financial arrangements to insure completion of all signed contracts either through bank deposit or bonding.

(g) Inform customer what service charge, estimate charge, and labor charge includes.

(h) Service sets in home whenever practical.

(i) Use factory-approved methods of doing installations and maintenance work. Use only new parts that are equal to original units.

(j) Return to customer all replaced tubes and/or parts when requested to do so.

(k) When an exchange of tubes and/or parts is not included in the regular charge, inform the customer of the exact charge to be made for such exchange, and give the customer the opportunity to make the exchange and delivery to the service company, if preferred.

(l) Issue only guarantees or warranties that are specific as to their application with respect to the effective period, parts, and labor.

(m) Give the customer an itemized statement showing materials installed and labor performed.

(n) Be honest and courteous and treat each customer in a professional manner.

(o) Accept and handle each complaint in a manner that will bring credit to the service industry as a whole, and abide by the decision of the review panel as set forth in the by-laws.

(p) Keep advertising free from statements of any type that might mislead or deceive the reader. When service charge is advertised, state what is included. Does charge include estimate, labor, and parts? State which. Do not advertise factory-trained technicians unless the person has been trained at a factory. Further, do not advertise factory approval or supervision unless your shop is approved or supervised *by* the factory.

Technical Training

The Associated Radio and Television Service Men of Chicago is an organization comprised of the owners of small shops in the country's second largest metropolis. In anticipation of the intensive promotion of color television receivers in the Chicagoland area the ARTS monthly lecture program for the 1954-55 season is devoted to a study of color television from the station's transmitter to the receiver in the customer's home.

The first lecture will deal with the theory of color transmission and the problems involved in the operation of a color TV transmitter; the second and third lectures will cover color TV picture tubes; the fourth definitely scheduled meeting will cover the theory of color mixing and the art of electronic reception for color reproduction as developed to date.

The RETMA Course

Other service associations are working with local educational authorities to make the industry-approved advanced television course available to technicians in their areas.

This industry-approved course was developed and proven in the New York Trade School with the cooperation of the service committee of the Radio-Electronic - Television Manufacturers Association.

The five-fold aims of the RETMA-endorsed advanced TV technicians' course are:

1. To increase the technical skill and proficiency of practicing service technicians by instruction in advanced servicing techniques, using the most modern test equipment and working on the latest model receivers.

2. To train practicing service technicians in the proper handling of new developments in circuitry.

3. To teach service technicians the basic elements of good customer relations.

4. To teach sound, approved business practices in the maintenance and conduct of their shops.

5. To indoctrinate practicing technicians in the benefits to be gained from adherence to ethical practices in their profession.

The Electric Institute of Washington, D.C. recently announced that it was making the industry-approved course available to practicing technicians in that area starting with the Fall semester. This objective was accomplished through the cooperation of an Industry Advisory Committee made up of distributors, educators, and service dealers in the Washington area.

Information about the RETMA-sponsored advanced TV technicians' course may be obtained by writing to Mr. A. Coumont, Service Co-ordinator, Radio-Electronic - Television Manufacturers Association, 777 Fourteenth Street, NW, Washington 5, D. C. —30—

Simpson TECHNICIAN'S TIMESAVER

PROFITABLE SHORTCUTS TO FASTER TV SERVICING

NOVEMBER, 1954 NEXT ISSUE, JANUARY

SAVE EACH ISSUE

HOW TO USE THE GENESCOPE* TO MAKE LOW-FREQUENCY TESTS IN COLOR-TV CIRCUITS

by Bob Middleton

FIELD ENGINEER, SIMPSON ELECTRIC COMPANY

GENESCOPE* or MODEL 479 Provides More Low-Frequency Test Data

The increased amount of test information which can be obtained with the use of the GENESCOPE or MODEL 479 was noted in the preceding issue. Fig. 1 shows the *remarkable performance* of the GENESCOPE and CHROMATIC PROBE in the checking of chroma circuits of color-TV receivers. The absorption-marker dips indicate the 50-kc point in the sweep output, *which extends below 8 kc*. Note also the extreme *flatness* of this low-frequency output, which is unmatched by any other service equipment, to the knowledge of the writer.

(*Continued on Next Page*)

BACK ISSUES OF "TECHNICIAN'S TIMESAVER" NOW AVAILABLE

A complete set of Bob Middleton's five popular articles is now available by special reprinting. Included are two valuable articles on servicing color-TV. To get your set, send 25 cents with your name and address to Simpson Electric Company, 5216 W. Kinzie St., Chicago 44, Ill.

Bob Middleton

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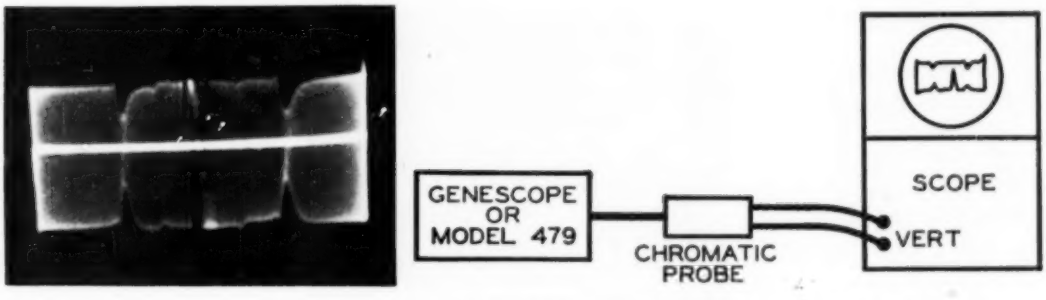

Fig. 1. A simple method of checking the flatness of the low-frequency output from the Chromatic Probe.* The sweep width of the Genescope is reduced to approximately 100 kc for this low-frequency check. The AM and FM tuning dials are tuned to the same frequency, e.g., 160 Mc. (Left) Result of the test. Note the remarkable low-frequency sweep output, down to 8 kc or lower. Absorption-marker dips are at 50 kc. Zero frequency appears in the center of the display.

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READY FOR COLOR!

The test equipment shown below and on the facing page was originally designed for black and white TV servicing. Today, it is very useful for COLOR servicing. If you already own one or more of these Simpson testers, you may be confident that your investment is still protected, despite rapid technological changes. If you plan to buy test equipment, ask your jobber for Simpson . . . you'll be ahead when you do.

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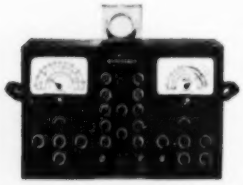

MODEL 480 FM-TV GENESCOPE DESCRIBED IN THIS ISSUE, $475.00

MODEL 406 CHROMATIC AMPLIFIER, $24.95

CHROMATIC PROBE $9.95

HOW TO USE THE GENESCOPE* TO MAKE LOW-FREQUENCY TESTS IN COLOR-TV CIRCUITS (Continued)

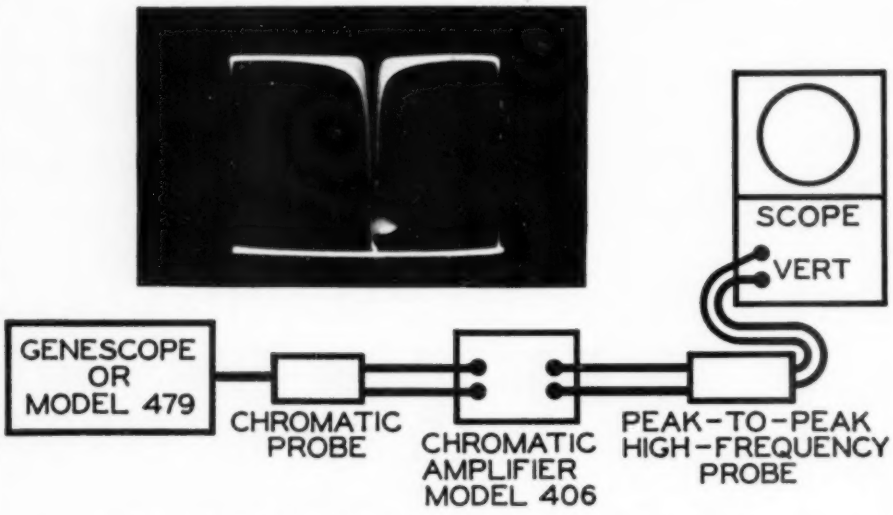

Fig. 2. The output from the CHROMATIC PROBE may also be tested by passing the signal through the CHROMATIC AMPLIFIER, demodulating the output, and displaying the sweep envelope on the scope screen. (Above left) Result of this test. The characteristic low-frequency "notch" appears because of the inability of the PEAK-TO-PEAK HIGH-FREQUENCY PROBE to completely rectify and filter a sweep signal at frequencies much below 100 kc.

Fig. 2 shows the characteristic difference in the sweep pattern when the output from the CHROMATIC PROBE is applied to the PEAK-TO-PEAK HIGH-FREQUENCY PROBE, before application to the scope. The demodulator probe develops the *wave envelope* of the sweep voltage, and also attenuates the lower-frequency end of the display, because service demodulator probes are not efficient at frequencies much below 100 kc.

Zero frequency appears in the center of the pattern shown in Fig. 2, because both FM and AM dials of the GENESCOPE are set to the same frequency, e.g., 160 Mc. If either dial is turned by a suitable amount, the zero-frequency point of the display will be brought to the end of the base line, as seen in Fig. 3.

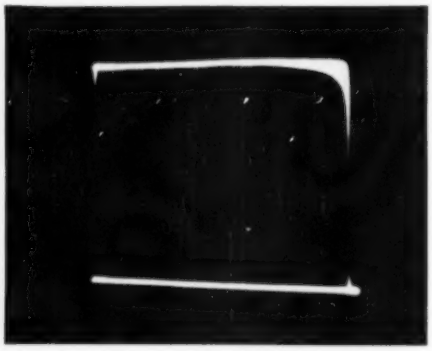

Fig. 3. The zero-frequency point appears at the center of the base line in Fig. 2. Here, the tuning dial of the GENESCOPE has been turned to run the zero-frequency point to the right-hand end of the base line. In this form, the pattern does not exhibit a twinned response.

Now, let us apply this knowledge to the practical testing of a chroma circuit in a color-TV receiver. When the output from the CHROMATIC PROBE is applied to the grid of the Q demodulator tube, and the PEAK-TO-PEAK HIGH-FREQUENCY PROBE is applied at the cathode of the Q phase splitter, the *frequency-response curve of the Q channel is obtained*, as shown in Fig. 4. The fuzziness of the display at the low-frequency end is caused by *incomplete rectification and filtering* of the video-frequency signal by the demodulator probe. There is also a substantial portion of the very low-frequency response missing (frequencies below 75 or 100 kc) because of this *limitation of the demodulator probe*, above noted.

Next, let the demodulator probe be disconnected, and the scope applied directly, as depicted in Fig. 5. Now, the *complete low-frequency response* of the Q channel, down to 8 kc, appears on the scope screen. This is an undemodulated type of display, just as Fig. 1 was an undemodulated type of display. The undemodulated display can be *marked in the same manner* as the demodulated display illustrated in the preceding issue of THE TECHNICIAN'S TIMESAVER.

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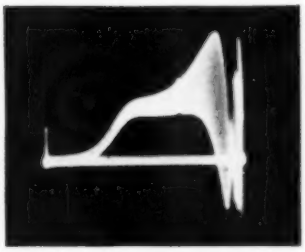


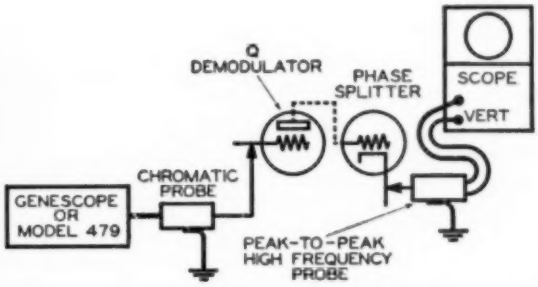
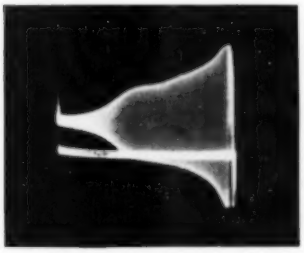


Fig. 4. The response of the Q demodulator (a typical low-frequency chroma circuit) can be obtained with this arrangement. However, as shown at left, the rectification and filtering of the PEAK-TO-PEAK HIGH-FREQUENCY PROBE is incomplete below 100 kc, and the arrangement shown in Fig. 5 is preferred for checking the low-frequency response.



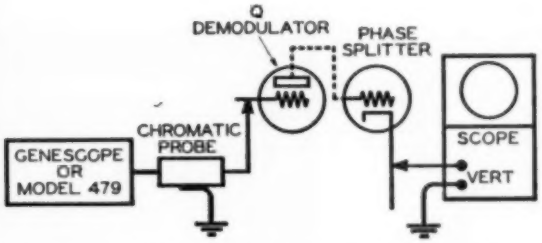


Fig. 5. The response of the Q demodulator can also be checked by applying the scope directly at the cathode of the phase splitter. This method displays an undemodulated pattern on the scope screen (see left), but utilizes the full output capability of the CHROMATIC PROBE. (Compare with display shown in Fig. 4.)

Vertical "Bounce" Caused by Line-Voltage Variation

When the scope is not used with a demodulator probe, but is applied directly at the cathode of the Q phase splitter, for example, it is often found that the pattern is not stable, but "bounces" erratically up and down on the scope screen as shown in Fig. 6. Sometimes the scope is unjustly blamed for this difficulty.

The bounce is due to the reproduction of small line-voltage variations by the low-frequency circuit under test. The remedy for the difficulty is to use a stable source of line voltage in making such tests. One of the most satisfactory methods of stabilizing the line voltage, when necessary, is to make use of an automatic line-voltage regulating transformer. Such a transformer not only eliminates bounce troubles, but also provides isolation from the power line; this latter point is of considerable importance in servicing some types of color-TV receivers in which one side of the power line is connected to the receiver chassis.

Still another advantage of the automatic regulating transformer is the maintenance of the power-supply voltages at standard values, which facilitates trouble analysis in the receiver circuits upon the basis of d-c voltage measurements.

(Continued on Next Page)

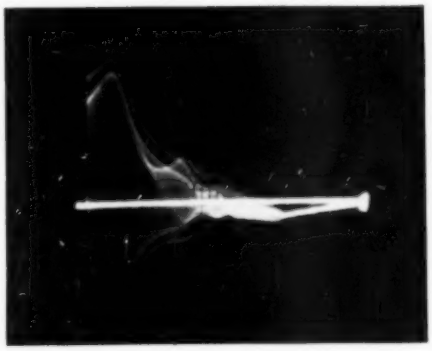


Fig. 6. Display of a low-frequency sweep response (within the frequency range of the scope) can be obtained by use of a low-capacitance probe, or direct cable, instead of a demodulator probe, and the extreme low-frequency display will be more accurate. However, small variations in line voltage cause the low-frequency output from the receiver to "bounce" on the scope screen, as shown above. It is advisable to utilize an automatic line-voltage regulating transformer for such tests.

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HOW TO USE THE GENESCOPE* TO MAKE LOW-FREQUENCY TESTS IN COLOR-TV CIRCUITS (Continued)

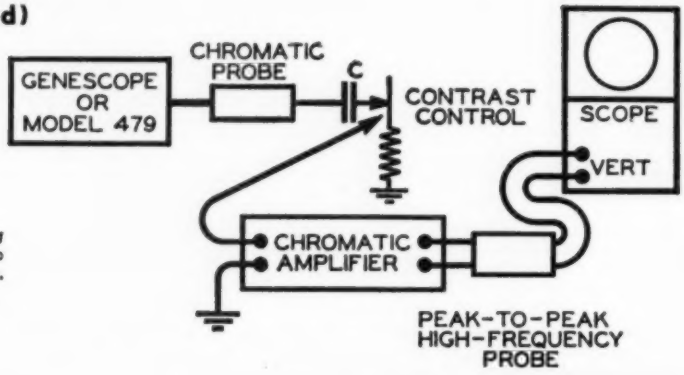

Fig. 7. Suitable method for checking flatness of sweep signal applied to contrast control in color-TV receiver. Result of test is shown in Fig. 8.

Blocking Capacitor Must Be Sufficiently Large

When there is a d-c voltage present at the signal-application point in the receiver, a *blocking capacitor* must be used to avoid drain-off of the d-c and disturbance of normal circuit operation. It is essential that this blocking capacitor be sufficiently large so that low-frequency attenuation is not encountered, as illustrated in Fig. 8. An electrolytic capacitor (properly polarized) can be used for this purpose, when a low-impedance circuit point is chosen for signal application.

It should be noted that no specific value can be established for such a blocking capacitor, because low-impedance loads require larger blocking capacitors than high-impedance loads. In any case, the best procedure is to make a sweep-flatness test, as shown in Fig. 7. The result should appear as shown in the top photo of Fig. 8, and tests may proceed from this point with confidence that an accurate sweep signal is being applied to the circuit under test.

Color Circuits Are Different

Color circuits are different! Synchronous demodulators are not demodulators at all, insofar as the sweep test signal is concerned. The input circuit to a synchronous demodulator may exhibit a surprising low-frequency *boost* to the test signal, which is not apparent during operation with a color-TV signal.

Answers to these and other puzzlers in the next issue.

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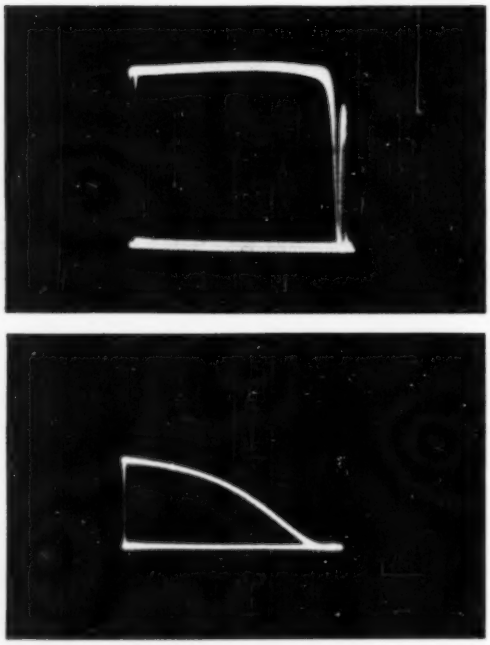

Fig. 8. (Above) Satisfactory flatness of sweep signal. (Below) Severe attenuation of low frequencies in sweep signal, due to use of blocking capacitor having too small a value.

Watch for next issue: "How to Check Synchronous Demodulators with the Genescope." It will be published in the next (January, 1955) issue of Radio and Television News.

SAVE EACH ISSUE

WRITE FOR BULLETIN 2052

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Good Quality Preamp

(*Continued from page* 43)

oscillation. The simplest and best solution is to use a separate power supply if possible.

Considerable attention was devoted to reducing hum in the amplifier. Hum was reduced to inaudibility by a combination of design practices and constructional features. Heater leads to the amplifier tubes are made of Number 22 switchboard wire. This wire has a very thin insulating covering and can be twisted very tightly. The wire also forms well and can be placed close to the metal base. Ceramic tube sockets were used. Mica-filled Bakelite should also be satisfactory, but trouble with leakage is sometimes experienced with ordinary Bakelite sockets. In addition to these constructional features, a potentiometer is placed across the heater circuit to allow a balance with respect to ground to be obtained. The rotor of this potentiometer is returned to about 20 volts positive rather than to ground potential.

The amplifier displays no hum and very little random-noise output with ordinary type 6SJ7 tubes. The 5693, which is a premium version of the 6SJ7, has also been used. This tube has considerably less microphonic output than the 6SJ7 even though microphonics have not been a problem with the 6SJ7. In addition, the 5693 appears to have a very low hum content. This was apparent since with 5693 tubes in place no hum was observed, irrespective of the position of the hum-balancing potentiometer. With the 6SJ7 tubes the balancing control had to be used to eliminate hum.

Operating Characteristics

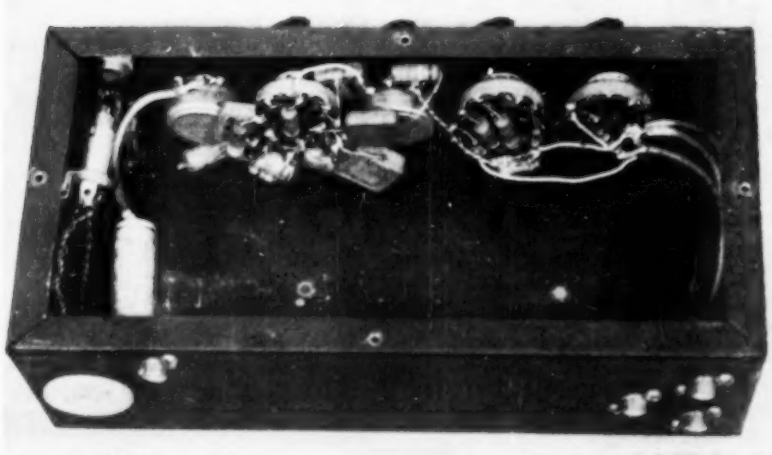
The original unit has been in use for over a year. The results have been outstanding. Universal comment among those who have heard it in comparison with other amplifiers has been most favorable. Most noticeable is the exceptional "cleanness" and "clarity" of the highs and the "depth" of the low frequencies.

The unit has not been provided with a bass-boost and attenuation control. However, there is less need for one when proper equalizing curves are available. There is a way provided to produce a similar result by switching to a higher or lower turnover frequency. In the opinion of many who have listened to the amplifier, this produces a more pleasing effect. The original unit was built with six turnover frequencies available. The accompanying plot of frequency vs amplification shows these characteristics. If more turnovers than those shown in the circuit are desired they can be added very simply by the addition of switch positions on the turnover control. These switch positions should insert a capacitance in series with the feedback loop equal to $1/4\pi f_t R_1$, where f_t is the turnover frequency, in cycles-per-second, desired.

A series of performance tests has been run on the preamplifier. A *Hewlett-Packard* Model 202A low-frequency function generator was available for these tests. The sine-wave response of the amplifier with all frequency-selective circuits inoperative extended from one cycle-per-second to over 300 kilocycles. Square-wave response was checked within the limits of the 202A function generator. Square waves showed negligible tilt at four cycles-per-second. At 1200 cycles, which is the upper limit of the generator used, square waves showed no overshoot or ringing and no trace of rounding. Advancing the high-frequency boost control produced no ringing effects. Intermodulation distortion was checked at an output level of four volts. No deflection of the intermodulation meter could be observed on the three percent full-scale range. An inspection of the equalization curves shows that the objective of extending equalization below audible frequencies has been met.

The general mechanical features of

Interior of cabinet with amplifier removed to show equalization network and controls.



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the preamplifier can be seen in the accompanying photographs of the original unit. The equalization system and other controls are mounted in a 5" x 10" x 3" chassis which serves as a cabinet for the amplifier. The amplifier itself is constructed on an aluminum bracket. This bracket is assembled with a shield and placed in the chassis. Connections to the equalizing network and other controls are made with shielded leads through the aluminum shield. As with any amplifier of this type, care must be taken when wiring to insure proper operation. Metallized paper condensers were used throughout. The small size of the preamplifier is largely due to their use. Power is brought in through an octal tube socket in the rear of the unit.

Several units have been built using the same mechanical features and layout so that any duplication of this preamplifier would probably be most successful if constructed along the same lines. —30—

"3D" Converter

(*Continued from page* 51)

due to frequency doubling and tripling within the speaker. Thus, the partial harmonic suppression through the "twin-T" feedback network actually results in a more faithful reproduction of the orginal sound at the speaker. Raising the "twin-T" resonant frequency would accentuate this effect, with even better results. Unfortunately, if this were done, resonance effects would result in ringing (damped oscillations) following the passage of a transient tone near the resonant frequency of the "twin-T through the circuit. This would create an artificial hangover effect which is neither desirable nor necessary with a stereophonic-type system. For this reason, both the resonant frequency and "*Q*" of the "twin-T" network have been kept relatively low.

As seen from Fig. 1, the "twin-T" net peaks at between 6 and 7 cycles which is certainly below the audible region. However, the increase in feedback and phase shift for frequencies from 50 cycles downwards does result in mild bass accentuation of the resonant type. It will be noted that the cathodes of V_{2A} and V_{2B} are connected to a common cathode resistor, R_{15}. No feedback or other interaction takes place due to this arrangement, since the cathode resistor is heavily bypassed by C_9. The separate outputs of V_{2A} and V_{2B} are coupled to individual cathode-follower output tubes, triodes V_{3A} and V_{3B}, which were incorporated for purposes of isolation, and to provide a reasonably low output impedance to allow the follow-up amplifiers to be located at a point remote from the sound converter if so desired.

The synthetic stereophonic outputs of the sound converter are finally ready for application to separate follow-up amplifiers. Fig. 2 shows the

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FT & T COAXIAL CABLE. RG-8/U. 110 ft. roll complete with PL-259 connectors at each end. Individually boxed and branded FT & T $5.95

NEW POWER TRANSFORMER. 110 V., 60 cy primary. 150 V., 30 MA secondary, 6.3-1 amp. fil. FB for grid dip kits, test equip and Bias supplies ..... 79¢ ea.—4 for $3

TS45/APM X-Band Signal Generator For small labs, schools and service shops. Hurry—while they last! $125

Western Electric HANDSET complete with cord. Xlnt. cond. FB for mobile and home telephone system. With F-1 unit $2.95

TV TUNERS. Standard coil. Cascode with 6BQ7, 6J6. New. With instructions. $13.95

500 OHM BRIDGE T PAD..79¢ or 2 for $1.50

APS 13 Makes a 420 MC RADIOPHONE

When converted with our easy-to-follow schematics and instructions. Range in most cases equal to 2 meters. Fine for communication, ranches, farms, $3.95 etc. ..... Complete with RF sections, conversion booklet, and 30 MC I.F. strip, less tubes, dynamotor and minor parts not needed for conversion. Shp. wt. 13 lbs.

SAVE ON COMMAND EQUIPMENT

Q5/RS, 190-550 KC. Like new, xlnt. cond. Check this price 9.95
T-21/ARC-5 5.3-7 MC Xmtr $6.95
R-27/ARC-5 6-9.1 MC Recvr 6.95
24V Filament Transformer for above 1.49
Command Set Tuning Knobs for above..ppd. .89

SPECIAL METER BARGAIN BUY!

Choice of 3" Black dialface, 0-750 MA, 500-0-500 Micro A" Panel Meters, round—or Weston 0-2.5 amps, DC ..YOUR CHOICE $3.95

METER SPECIAL! 0-4 amps. rf. GE 3-inch round enclosed in aluminum case. A must for accurate XMTR. output readings $3.95

NOVICE BAND CRYSTALS ..... 89¢

CONTROL RECTIFIER. Input 115 V. 21 phase. 400 cycles 1.6 amps, 175 watts. Output 115V. DC. 0 to plus or minus 6 amps. Originally used with model SF Radar Equip. Less tubes. Xlnt. condition $14.95

HI-VOLTAGE FAN BELT GENERATOR for mobile rigs. 1000V @ 500 MA from fanbelt—for 200 to 300 Watt outputs. Complete with pulley, voltage regulator, hookup diagram, xmtr. tube and circuit comb—ready to Install! $24.95

24V GENERATOR, brand new $9.95

24 V. Transformer & Rectifier Comb.

A basic 24 V DC power supply consisting of 110 V. AC primary, 24 V. secondary, and a Rectox Rectifier. Normally rated at 1 amp—but operates intermittently up to 3 or 4 amps. Worth at least $8.95.... $2.95

701A XMTR. TUBES 2.95 2 for $5
While they last at this reduced price! New, with dope sheet.

FILAMENT TRANSFORMERS for these, only... $2.95
Sockets..$2 or 2 for $3

DuMont 3GP1 Cathode Ray Tubes
$1.79 3 for $5
Same as used in Dumont 224A oscilloscope. New orig. boxes. With Schematic.

RCA SURPLUS TV CAMERA

New Low Price! $225

With 1846 iconoscope and 6-stage video amplifier and clipper. For movie pickup chains and training and experimental work. Complete info on request—but hurry as they won't be around long at this new low price!

COAX ANTENNA for fixed station xmtrs working with mobile. Freq. 30-40 MCS. Complete with 100' RG8/U cable and adaptor. New $49.95

TEST OSCILLATOR for model ZA blind landing equip. Puts out 75 MC signal as a marker. Can be modified for other uses. New, boxed $1.95

WRITE FOR FREE CATALOG! All shipments F.O.B. Warehouse! No COD's please—Calif. buyers add 3% sales tax.

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CABLE: Harjo Phone: Victoria 9-2411

block diagram of a typical configuration. Conventional 10-watt amplifiers would be ideal for this application. Two similar, modestly priced, extended-range speakers are more than adequate to round out the system. Experiments with a variety of two-way speakers and high-priced single units revealed little, if any, gain in apparent range and quality. A word on speaker placement: Naturally, the two speakers should be housed in separate enclosures to obtain the most realistic stereophonic effect. The actual geometry of speaker placement depends on the characteristics of the individual room and can best be arrived at by means of experimentation. The bass-predominant speaker may be placed in a resonant type enclosure if desired, but the treble-predominant unit should be mounted in nothing more elaborate than an open-type baffle, preferably tilted somewhat from the vertical. The open-back baffle eliminates middle-frequency cabinent resonances which are undesirable, and the tilting prevents cancellation effects at frequencies corresponding to room dimensions.

Upon completion of his converter, the writer found that the individual channel level controls on the converter were more or less duplicated by the individual master gain controls of the follow-up amplifiers. Perhaps these controls should have been eliminated on the converter, but more flexibility is provided by having them both on the converter chassis. On the other hand, tone controls were eliminated from the converter in the belief that the follow-up amplifiers would have them. Once these are adjusted to types of records or room acoustics, little further adjustment is needed. —30—

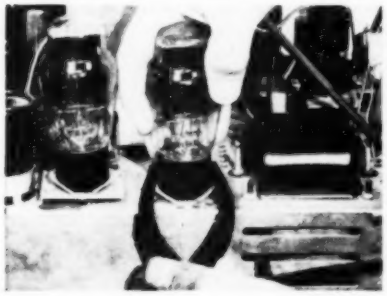
RECTIFIER TUBE REMOVAL

CERTAIN TV rectifier tubes, as most models with type 5U4 tubes, use spring clips for more firm seating of the tube.

Since these clips must be held down when removing the tube, the handles of pliers work well in one hand as shown. While the pliers shown have insulated handles, tape over any type plier handle will lessen the possibility of damage to nearby tubes.

The TV receiver should have been disconnected from the wall outlet, preferably for some time, before removing such tubes. . . . . H. L.

Tape your pliers handles and then use them for removing those hard-to-get-at TV tubes.



.. fantastic!

THE Rebel KR-5

20" CORNER FOLDED HORN

THE LITTLEST REBEL. The KR-5, approaches Klipschorn performance on light, middle bass. Heavy pipe organ bass is even more amazing with smooth, clean reproduction completely free from unmusical boom and distracting distortion. This latest Klipsch design by Cabinart, fifth in the CABINART-KLIPSCH REBEL series, is available in all fine woods, utility birch and, for portable hi-fi, strikingly smart leatherette.

Wall mount the Rebel 5, hang or set it in a corner. Place it on a table — a bench — a shelf — anywhere! Performance . . . absolutely unbelievable!

See your nearest Cabinart hi-fi dealer or write for catalogs.

Finished $48.00 **Utility $33.00**

Cabinets by Cabinart

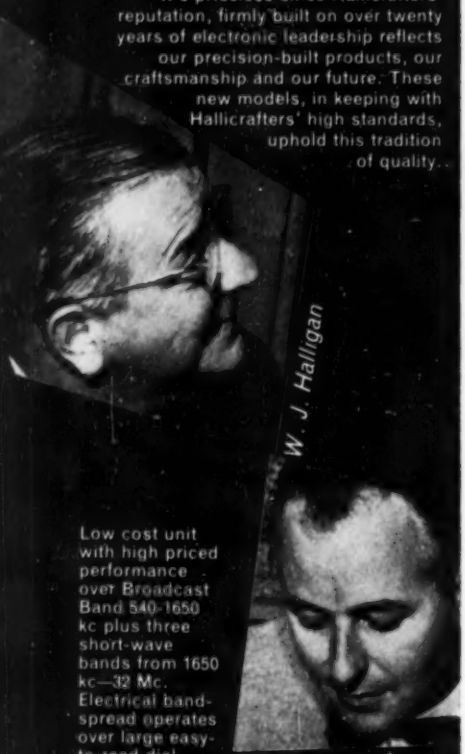
75 North 11th Street, Brooklyn 11, N. Y

NEW

AGAIN, *FIRST* WITH THE *LATEST!*

What's a reputation worth?

It's priceless since Hallicrafters' reputation, firmly built on over twenty years of electronic leadership reflects our precision-built products, our craftsmanship and our future. These new models, in keeping with Hallicrafters' high standards, uphold this tradition of quality.



Low cost unit with high priced performance over Broadcast Band 540-1650 kc plus three short-wave bands from 1650 kc—32 Mc. Electrical band-spread operates over large easy-to-read dial. Headphone tip jacks on rear and powerful built-in PM speaker. Oscillator for reception of code signals. Four tubes plus rectifier. 105/125 V. 50/60 cycle AC/DC $49.95

Model S-38D

These two new Civic Patrol receivers are over 10 times as sensitive as previous models, greater increased audio power output and built-in relay squelch system. Perfect for monitoring, police, fire, taxicab, telephone-mobile, forestry, Civil Defense. The S-94 covers 30-50 Mc and the S-95 150-173 Mc. Built-in speaker and provisions for headphones. Eight tubes plus rectifier. 105/125 V. 50/60 cycle AC/DC $59.95

Write for complete specifications.

Model S-94 (S-95)

hallicrafters

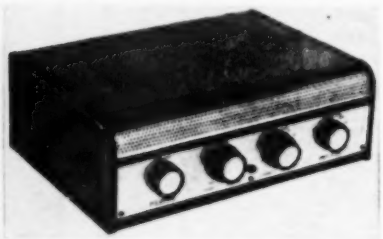
CHICAGO 24, ILLINOIS

NEW EQUIPMENT FOR THE AUDIO TECHNICIAN

15-WATT AMPLIFIER

Pilot Radio Corp., 37-06 36th Street, Long Island City, N. Y., is now offering a *Williamson*-type audio amplifier with push-pull 5881's.

The 15-watt *"Pilotone"* AA-420 unit



provides full 15-watt output combined with a professional preamplifier. It uses six tubes plus a rectifier. Dual equalization switches provide five positions of treble roll-off and five positions of bass turnover. The loudness control has individual level setting controls for three inputs.

NEW RECORDER LINE

Tape Recorders, Inc., 1501 W. Congress St., Chicago 7, Illinois, has recently entered the magnetic tape recording field with a complete line.

The featured unit of the new line is the "Dixie-Land" which is designed to meet the mass market demand for a trouble-free unit which is easy to operate and ruggedly constructed.

The company will send details on their complete line to those writing the firm direct.

FM TUNER

Sargent-Rayment Co., 1401 Middle Harbor Road, Oakland 20, California, is currently marketing a professional-type tuner tone control, the SR-808.

Among the features of this new unit are dual concentric bass, treble, and

volume, allowing maximum flexibility. The bass can be varied plus or minus 12 db while an independently-operated tap control varies the turnover point and rumble filter. The treble control can be varied over the same range while an independently-operated *m*-derived low-pass noise filter chops four positions at a rate of 26 db per octave.

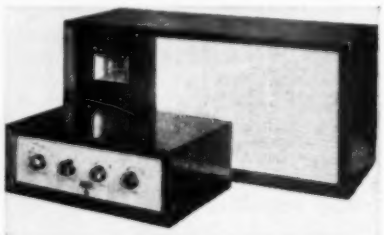
The tuner features three positions of record compensation, two types of phono inputs, a separate FM jack for multiplex binaural broadcasting, in addition to AM-FM.

SPEAKER-AMPLIFIER SYSTEM

Altec Lansing Corporation of 161 Sixth Ave., New York 13, N. Y., has recently introduced a new loudspeaker-amplifier system, the "Melodist."

This compact unit features a speaker which is small enough to fit on any record shelf yet provides frequency coverage from 90 to 22,000 cps. The speaker unit uses a 10-inch woofer and a high-frequency tweeter.

The 10-watt amplifier has three inputs, crossover selection, separate bass



and treble tone controls, and a loudness control.

Both of the units are available in mahogany or blonde. The entire combination is moderately priced.

LINEAR AMPLIFIER

Don McGohan, Inc., 3700 W. Roosevelt Road, Chicago 24, Ill., is now offering a moderately-priced linear amplifier, the Model WA-330.

The new unit has less than 1% intermodulation distortion at full output and harmonic distortion below .5% at 30 watts. Frequency response is 20-60,000 cps ± 1 db at high output. At low power the response is 20-100,000 cps ± 1 db. The amplifier and power supply are compactly arranged on a single chassis measuring 14" long by 7½" deep. The unit has two a.c. outlets for powering a preamplifier, tuner, and record changer.

Output impedance is 8 and 16 ohms, feedback is 20 db, and hum level is 90 db below 30 watts.

NEW BAFFLE LINE

Argos Products Co., 4753 N. Broadway, Chicago 40, Illinois, has introduced a new speaker baffle line which features a woven plastic grille cloth which covers the entire front of the baffle except for a narrow edge.

A full-sized piece of hardboard under

"G-E FIELD CLINICS LIKE MONEY FROM HOME..."

Patchogue's TVs stay in apple-pie order—thanks to experts Ed Barowski, Mike Maletta and Jack McCafrey (l. to r.).

"PAY OFF IN NEW SET ORDERS, TOO"

—says enterprising Long Island TV shop owner

Mike Maletta

President
Maletta's Radio Shop Inc., Patchogue, N. Y.

WRITES Mr. MALETTA:

"Selling TV sets is probably the most competitive business in America today. Any advantage a manufacturer can furnish helps put his dealers out front. G.E.'s Field Clinics are like money from home. Our men attend every one in this area—now we're doing two repair jobs in the time we used to need for one. Folks have confidence in us—and that pays off in new set orders every day of the week."

We can't add a thing to Mr. Maletta's letter except this: Contact your G-E Distributor now for the place and date of the next G-E TV Field Clinic near your shop. General Electric Company, Radio & TV Dept., Electronics Park, Syracuse, N. Y.

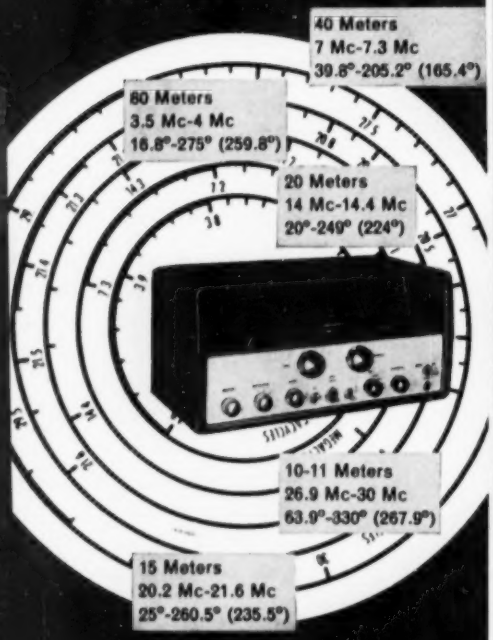
Progress Is Our Most Important Product

GENERAL ELECTRIC

Leading a brand new line...

1000°

OF CALIBRATED BANDSPREAD!



MODEL S85
S-85 Receiver (AC)
S-86 Receiver (AC DC)
105/125 V. 50/60 cycle
Either $119.95

We here at Hallicrafters are proud of our new communications line, especially the new S-85 receiver with over 1000° of calibrated bandspread. Broadcast band 540-1680 Kc and three short-wave bands 1680 Kc—34 Mc on large easy to read dial. Separate bandspread tuning condenser and built-in speaker. Seven tubes plus rectifier. Coupon below brings complete specifications.

Used by 23 governments
Sold in 89 countries

hallicrafters
Chicago 24, Illinois

MAIL THIS COUPON

FREE ☐ World-wide time converter
Specification sheet ☐ S-85(S-86)
☐ S-95(S-94) ☐ S-38D
Name_____
Address_____
City_____ Zone____ State____
☐ Ham (call letters_____) ☐ Listener
Occupation_____

the grille cloth is cut for the proper speaker opening. The hardboard offers the advantage of better acoustical properties and freedom from warpage. The corner baffles are bass reflex and are available in sizes suitable for 4 and 5, 6, 8, 10, and 12 inch speakers. The units are available in blonde leatherette at no extra charge if desired.

REVERE TAPE RECORDER

Revere Camera Company of Chicago has introduced a two-speed tape recorder which incorporates the firm's "balanced tone" feature.

The new unit has two acoustically matched, extended excursion speakers

and an ingenious perforated case which provides full 360 degree sound distribution. Single knob control and the company's index counter makes operation simple and gives instant location of any portion of the recorded reel.

The recorder is housed in a modern carrying case of Irish linen, custom bonded to indestructible fiber-glass, and has a retractable carrying handle for lightweight portability.

NEW MAGNETIC TAPE

Minnesota Mining and Manufacturing Co., St. Paul, Minn., has introduced a new magnetic tape that automatically increases the recording time of any tape recorder by 50 per-cent.

The new *"Scotch"* brand "Extra-Play" magnetic tape 190 marks the first time since the advent of dual track recording that a major increase in recording and playback time has been possible without decreasing the tape speed or employing a larger reel.

The principal feature of the tape is a new high-potency oxide coating only half as thick as standard coatings but with equivalent magnetic properties. Coupled with the high-potency oxide is a new, thinner backing of tough cellulose acetate.

12-INCH TURNTABLES

Rek-O-Kut Company, 38-01 Queens Blvd., Long Island City 1, N. Y., has announced the availability of two new 3-speed, 12" precision turntables.

Known as the "Rondine" turntables, the Model B-12 is powered by a specially-designed 4-pole induction motor while the deluxe Model B-12H employs a new type, custom-built hysteresis synchronous, self-lubricating motor. Aside from the motors, the two turntables are identical. A single selector knob is used for setting the desired speed. Between the speed settings are intermediate "off" positions. This permits the turntable to be operated at any selected speed and then shut off without going through all of the speeds.

MAGNETIC DISC RECORDER

The Electronic Division of *The United States Time Corporation*, 500 Fifth Ave., New York, N. Y., is now marketing a new magnetic disc recorder, the "Timex."

Priced competitively, the new unit records voices of members of the family as well as television and radio programs. It immediately plays back the results. With a minor adjustment, it can be quickly converted into a standard 45 rpm record player.

The recording discs used with this instrument are so flexible and compact that they can be folded and mailed like an ordinary letter. More than 100 of them can be stored in the space required for one 7" phonograph record album.

CRYSTAL CARTRIDGES

Shure Brothers, Inc., 225 W. Huron St., Chicago 10, Ill., has introduced three new crystal cartridges which are said to replace 210 cartridge types currently in use.

The Model W78 is a dual-volt, dual-weight unit which can be used in 149 replacement applications. It will replace steel or aluminum cased cartridges of either high or low output.

The Model W68 is a "muted stylus," dual-weight cartridge. It can replace either aluminum or steel cased cartridges without adjusting tone arm balance. It is equipped with the A62A silent-tracking "muted stylus" needle. The Model W70 uses pin jacks and eliminates the laborious threading of leads through the tone arms.

DYNAMIC MICROPHONES

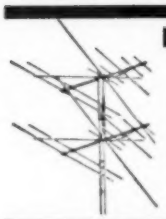
Electrovert Inc., 489 Fifth Ave., New York 17, N. Y., is introducing a new line of Austrian-made microphones to the American market.

Among the units currently available are the D 10 omni-directional and D 11

cardioid microphones. The D 10 has a frequency range of 60 to 10,000 cps, omni-directional spherical directional characteristics, and an impedance of

Remember QUALITY CANNOT BE UNDERSOLD

This is our 34th YEAR as RADIO PARTS Distributors



DOUBLE CONYAGI

The equivalent of 40 dipoles

Newest development for long distance TV reception. MONEY BACK GUARANTEE. This is a BIG ANTENNA. Reflectors 9 feet long. Conical elements over 10 feet long. Solid rugged wind proof construction.

List Price $49.95 ..... **$15.95**

CONICAL TV ANTENNA

10 Element conical . . . rugged throughout. Only **$3.95**

Doudble bay array, with stacking bars **$7.25**

4 Bay array, with harness and stacking bars **$14.95**

RADAR TYPE TV ANTENNA

For UHF and VHF RECEIVES ALL CHANNELS

212 miles reception recorded. 125 miles common. This unbeatable antenna has been reinforced to withstand 150 mile winds.

Satisfaction guaranteed or your money back. Less Mast, List Price $49.95.

Your Cost **$19.95**

300 OHM TWIN LEAD

55 Mil, 100 ft. $1.59

1000 ft. **985**

20 Ga., 80 Mil, 100 ft. 1.89

1,000 ft. 16.95

UHF TUBULAR 300 OHM LINE

1,000 ft. **$29.50**

100 ft. **$3.95**

All Channel Foam Line, 100 ft. for $6.95. 50 ft. for $3.95.

FOUR CONDUCTOR

Rotor Cable Clear or Brown. Very Special, 1,000 ft. **$14.95**

100 ft. **$1.95**

UHF BOW TIE ANTENNA

Factory assembled, single-bay Each $2.39

Two-bay array with matching device $4.59

TV MASTS AND HARDWARE

Bargain Chimney Mount ..... Net $1.49

Vent Mount $1.89

Stainless Steel Chimney Mount. Net **$2.50**

Twin lead ins ..... each 3c

Mortar nail insulator ..... each 8c

Mast ins ..... each 15c

Ten foot mast. Seamless, expanded end, sturdy enough for the largest arrays.

Only ..... each **$2.39**

5 ft. DURABLE MAST, heavy gauge 1¼ diam, with interlocking end. Slip two sections together for a ten-footer. 5 sections = 25 ft. Each section $1.25

PREMIER Unconditionally Guarantees All Tubes For One Full Year

VERY BEST BRANDS AVAILABLE FOR IMMEDIATE DELIVERY. INDIVIDUALLY BOXED.

0A4G	1.19	6AC5GT	.89	6F5GT	**59c**	6X8	1.29	12BH7	.89	35Y4	**85c**
0Z4	**59c**	6AC7	1.49	6F6GT		6Y6G	**69c**	12BY7	.89	35Z3	
0Z4O		6AF4	1.76	6F7	1.59	6Z4/84		12DZ7	1.19	35Z4	.69
1A5GT	.79	6AG5	.99	6F8G	1.59	7A4	.95	12F5GT	.69	35Z5	.59
1A7GT	.79	6AG7	1.49	6G6G	.95	7A5	1.19	12H6	.89	35/51	.79
1B3GT	.95	6AH6	1.89	6H6GT	.89	7A6	.89	12J5GT	**69c**	36	**95c**
1B5	**29c**	6AJ5	2.95	6J5GT	.59	7A7	**79c**	12K7GT		37	
1H4		6AK5	.89	6J6	.79	7A8		12K8	.89	38	**88c**
1H5GT	.59	6AK6	1.19	6J7G	.69	7B4	.89	12Q7GT	.89	39/44	
1J6GT	**59c**	6AL5	**69c**	6J8G	1.19	7B5	.89	12S8	.89	41	
1L4		6AQ5		6K5GT	.69	7B6	.89	12SA7GT	.69	42	**69c**
1L6	1.29	6AQ6	.79	6K6GT	.59	7B7	**89c**	12SC7	.95	43	
1LA4	1.19	6AQ7	1.19	6K7GT	.69	7B8		12SF5GT	.69	45	
1LA6	1.19	6AR5	.79	6K8GT	1.19	7C4	1.29	12SF7	.95	45Z5	.69
1LC5	.69	6AT6	.59	6L5G	.95	7C5	.89	12SG7	.89	46	
1LC6	**1.19**	6AS5	.89	6L6G		7C6	**79c**	12SH7GT		47	**89c**
1LD5		6AU5GT	1.29	6L6GA	**1.39**	7C7		12SJ7GT	**69**	50A5	.95
1LE3	1.19	6AU6	.59	6L7	1.19	7E5	**79c**	12SK7GT		50B5	
1LH4	1.19	6AV5GT	.89	6N6G	1.29	7E6		12SL7GT		50C5	**69c**
1LN5	1.19	6AV6	.59	6N7GT	1.19	7E7	**79c**	12SN7GT	.95	50C6G	1.29
1N5GT		6AX4	.69	6P5GT	.69	7F7		12SQ7		50L6	.79
1P5GT	**79c**	6AX5	.79	6Q7GT	.59	7F8	1.49	12SQ7GT	**69c**	50X6	.69
1Q5GT		6AX6	.69	6R7GT	.69	7G7	1.19	12SR7GT		50Y6	.95
1R5		6AY5GT	.89	6S4	.59	7H7	.95	1Z3	.95	57	**79c**
1S4	.95	6B4G	1.29	6S7GT		7J7	**1.19**	14A7	**95c**	58	
1S5		6B8GT	1.19	6S8GT	**1.19**	7K7		14AF7		70L7	**1.49**
1T4	**69c**	6BA6	.59	6SA7GT		7L7	.79	14B6	**89c**	70L7GT	
1U4		6BA7	.89	6SC7	**69c**	7N7	.69	14B8		71A	**79c**
1U5	.59	6BC5	.69	6SD7GT	.99	7Q7	.79	14C5	1.19	75	
1V		6BD5GT	.89	6SF5	.59	7R7	1.19	14C7	**95c**	77	.69
1X2A	**89c**	6BE6	.59	6SF5GT		7S7	1.19	14F7		78/6D6	.95
2A6		6BF5	**69c**	6SG7	.59	7V7	.79	14F8	**1.29**	80	.69
2A7		6BF6		6SH7GT	**69c**	7W7	1.19	14H7		83	1.49
2B3	.89	6BG6	**1.89**	6SJ7		7X6	.95	14Q7	.95	84/6Z4	.69
2B7	.89	6BG6G		6SJ7GT	.79	7X7		14W7	1.19	85	.79
2E5	.89	6BH6	**69c**	6SK7GT	**59c**	7Y4	**79c**	14X7	1.19	VR90	
2X2/879	.79	6BJ6		6SL7GT		7Z4	.89	19BG6	**1.89**	VR105	**$1.19**
3LF4	1.29	6BK7	1.19	6SN7GT	.79	12A7	1.49	19BG6G		VR150	
3Q4	.59	6BL7	.79	6SQ7		12A8	.69	19T8	.89	VT51	**29c**
3Q5GT	.89	6BN6	1.19	6SQ7GT	**59c**	12AH7	1.49	24A	.69	VT52	
3S4	.69	6BQ6G	1.19	6SR7GT		12AL5	**59c**	25AC5GT	1.19	1LN7	1.49
3V4	.95	6BQ6GT	1.19	6SS7	.99	12AT6		25B6	**1.19**	1LT4	1.89
5T4	1.29	6BQ7	**1.29**	6T8	.89	12AT7	.89	25B6GT		1N7G	1.89
5U4G	.69	6BZ7		6U5		12AU6	.69	25L6GT	.59	1P7GT	1.89
5V4G	.89	6C4	.59	6U6GT	**69c**	12AU7	.79	25W4GT	.69	1T7	.59
5W4		6C5GT		6U7G		12AV6	.59	25Z5	.69	1U7	1.19
5W4GT	**59c**	6C6	**69c**	6U8	.89	12AV7	.89	25Z6GT	.69	1Z7GT	.95
5Y3GT	.49	6CB6		6V3	1.29	12AW6	1.19	32L7GT	.95	2A3	**59c**
5Y4G	.59	6CL6	1.29	6V6GT	.69	12AX4	.69	26		35A5	.95
5X4G	**97c**	6CD6	**1.89**	6W6GT	.69	12AX7	.89	27	**59c**	35B5	
5Z3		6CD6G		6W7	1.89	12AY7	1.89	35A5	.95	35C5	**69c**
6A7	.89	6CF6	**1.19**	6X4	**59c**	12BA6	.59	35B5		35L6	
6A8GT	1.29	6D6/78		6X5GT		12BA7	1.19	35C5		35W4	.59
6AB4	.69	6D8G	1.19			12BE6	**69c**	35L6			
6AB7	1.19	6E5	.69			12BF6		35W4			

10% DISCOUNT ON ORDERS OF 100 TUBES OR MORE—
5% DISCOUNT ON 50 TUBE ORDERS

FILTER CONDENSERS

FP Type or Tubular with Leads—Fresh Stocks Always

.5 mfd.	450V.	.35	10 mfd.	50V.	.19
.5-.5	450V.	.45	20-	50V.	.19
1.0-	450V.	.39	20-	50V.	.25
1.0-1.0	450V.	**.45**	50-	50V.	.25
20-	450V.		100-	50V.	.39
20-20	450V.	.49	20 mfd.	150V.	.35
30-	450V.	.45	20-20	150V.	**.45**
30-30	450V.	.59	30	150V.	
40	450V.	.49	30-30	150V.	.49
40-40	450V.	**.69**	40	150V.	.49
60	450V.		40-20	150V.	
60-40	450V.	.89	40-40	150V.	**.49**
80	450V.	.69	80-30	150V.	.49
80-40	450V.	1.29			

MISCELLANEOUS BUYS

6-foot LINE CORD UL. ..... 10 for **$1.00**

TV INTERLOCK CORDS ea. 49c

I. F. TRANSFORMER— 456 Kc. 19c

PILOT LIGHTS. Type No. 47 10 for 39c; 100 for $2.95

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SINGLE ION TRAPS 19c

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OUTPUT TRANSFORMER—for 50L6, 29c; for 6V6, 39c

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BEST BRANDS AT BEST PRICES

3V4, 1T4, 1R5, 1S5 ..... **$2.19**

3Q4, 1T4, 1R5, 1S5. List Value $8.00. Tube Kit only **$1.98**

3S4, 1T4, 1S5, 1R5. List Value $7.80. 4-Tube Kit **$1.98**

1U4, 3S4, 1S5, 1R5. List Value $7.80. All Four Tubes for **$1.98**

117Z3, 1U5, 3S4, 1R5, 1T4, AC-DC Portable Kit. All for **$2.49**

12AT6, 12BA6, 12BE6, 35W4, 50B5. 5 Tubes for **$2.59**

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65 mil	$ .69
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12" COAXIAL PM SPEAKERS. High Fidelity with Crossover filter attached. 20 watts; 40-15,000 cps. response; 8 ohm Voice coil ..... ea. **$12.95**

10" coaxial speaker. Take advantage of your TV set's FM sound. This speaker matches and replaces 80% of all TV speakers **$10.95**

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All Tubes Have Daylight Type Dark "A" or "B" Faces

SIZE	PRICE	SIZE	PRICE	SIZE	PRICE
7JP4	17.95	16KP4 16"	21.95	20CP4 20"	27.95
8DP4	18.95	16LP4A 16"	24.20	20DP4 20"	29.45
10BP4B 10"	14.95	16RP4 16"	21.95	20NP4 20"	29.45
12JP4 12"	17.95	16TP4 16"		21AP4 21"	30.10
12LP4B 12"	17.95	16WP4A 16"	22.20	21EP4 21"	31.95
12UP4A 12"	19.40	16YP4A 16"		21FP4 21"	31.95
14BP4 14"	20.40	17BP4A 17"	22.95	21MP4 21"	31.95
14CP4 14"	21.90	17CP4 17"	25.40	21WP4 21"	36.95
14GP4 14"	21.90	17GP4 17"	26.90	21YP4 21"	31.95
14HP4 14"	22.50	17HP4 17"		21ZP4 21"	31.95
15AP4A 15"	22.50	17LP4 17"	26.90	24AP4 6 mo.	83.95
16AEP4 16"	22.50	17TP4 17"	26.90	24CP4 24"	62.50
16AP4B 16"	22.60	19AP4B		24DP4 24"	
16DP4A 16"	22.20	19DP4B	28.80	27EP4 27"	76.90
16EP4A 16"	22.20	19FP4B		27GP4	
16GP4B 16"	24.20			27LP4	**79.95**
16JP4A 16"				27NP4	
				27RP4	

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15 MONTH GUARANTEE ON ALL TYPES
SEND 25% DEPOSIT AND WE WILL SHIP FROM STOCK IMMEDIATELY

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Insulated ½, 1 and 2-watt assortment of most used values, I. R. C. Ohmite, Stackpole, Speer.

100 for.. **$2.95**

Flyback Transformer TV Horizontal output, universal replacement, 14,500 V.

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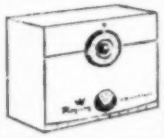

REGENCY RC-53

All channel UHF Converter. Much more gain than strips, and fits any set. Only ... **$14.96**

21" TV CONVERSION KIT COMPLETE WITH CABINET AND NEW TUBE

15 Month Guarantee

Now you can make that conversion. This table model cabinet eliminates your bottle neck. Supplied complete with 21" picture tube, 70 degree yoke, gold mask and safety plate, fly back transformer and width coil, every easy to install and all for **$50.00**

TV CONVERSION KITS

ALL NEW TUBES

15 Month Guarantee

Easily installed consisting of rectangular tube, 70 degree yoke, beautiful mask, flyback transformer and width coil.

17" Kit, as above, complete	$25.95
20" Kit, as above, complete	29.95
21" Kit, as above, complete	34.95
24" Kit, Rectangular	79.95
24" Kit, Round	69.95
27" Kit, as above, complete	99.95

24" & 27" Rectangular Kits contain 90° yoke.

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Very best quality—NATIONAL BRANDS. Individually Packed.

3"	ea. $1.39	8"	ea. 3.23
4"	ea. 1.59	10"	ea. 5.10
5"	ea. 1.59	12"	ea. 5.95
6" Special Price	ea. 1.79		

5 x 7, 6 volt field auto radio speaker $1.89

New WEN "Quick HOT" SOLDERING GUN

Extra long narrow tips to reach tight spots. Practically indestructible.

Featherweight but 135 watts!

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TERMS: 25% DEPOSIT with order, balance C.O.D. ALL shipments F.O.B. Chicago. ORDERS LESS THAN $5.00—$1.00 SERVICE CHARGE. CABLE ADDRESS: CONTULAB. These prices supersede all previously advertised prices, subject to change

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W9WJV beats last year's Field Day record with **hallicrafters**

Lawrence T. Fadner, team captain in Chicago's 1954 North Suburban Ham Club ARRL 40 meter CW Field Day bettered the club's last year record by nearly 30%.

and Hallicrafters SX88 is hot news too. More hams are telling each other about this new receiver than about any equipment in years.

Used by 33 governments, sold in 89 countries

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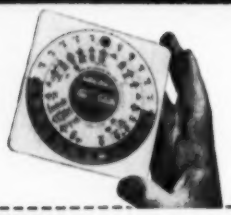
CHICAGO 24, ILLINOIS



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☐ Ham (call letters_____) ☐ Listener

Occupation_____

Hallicrafter equipment I would like to know about:

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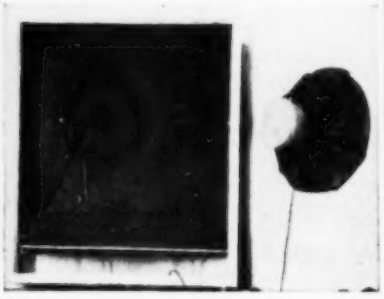
40,000 ohms. It weighs 10 ounces including the desk stand and 5 foot cable. The D 11 covers the same frequency range, has uni-directional cardioid characteristics, an impedance of 40,000 ohms, and weighs the same as the D 10.

The New York distributor will supply complete details on the line upon request.

ACOUSTICAL FELT

American Felt Company of Glenville, Conn., is now offering a new acoustical felt for damping the speaker chambers in high-fidelity audio systems.

The new product is effective in con-



trolling unwanted sounds. The type "K" felt has been used as acoustical insulation in airplanes but has recently been adapted for audio purposes.

TAPE REEL LABELS

Orradio Industries, Inc., T-120 Marvyn Rd., Opelika, Alabama is now offering sound tape reel tabs which help provide clear and permanent identification of recorded reels.

The new tab is designed to replace the makeshift scraps of paper and china crayon markings which are often used for labelling purposes. The tab fits snugly beneath the edges of any 7" plastic or metal reel, whether the reel is full, half full, or empty. It is made of sturdy stock and has plenty of room for identification on both sides.

Nat Welch of the company will forward a free tab to professional tape users who write him direct.

"UNIVERSAL" CARTRIDGE

Webster Electric Company, 1900 Clark Street, Racine, Wisconsin, has announced an addition to its "Featheride" line.

The new universal cartridge, the WX, is a single-needle, dual-voltage model for either 78 rpm or three-speed use. For high-voltage applications it develops 5 volts at 78 rpm or 2 volts at 33⅓ and 45 rpm. Using the shunting condenser which is furnished with the cartridge for low-voltage use, the WX develops .75 volt at 33⅓ and 45 rpm or 1.5 volts at 78 rpm.

The Sound Sales Division of the company will forward a copy of Bulletin Y-F4, containing full details, upon request.

LOW-FREQUENCY SPEAKER

Stephens Manufacturing Corporation of Culver City, California, is now offer-

SALES A-POPPIN'!

ARB NAVY RECEIVER 105 to 9050 KC. Four Bands, Calibrated Dial, LF Ship BC—80 & 40 Meter—Complete with Tubes and Dynamotor. For 24 Volt operation; easily converted to 110 V—12 or 6 Volt. Size: 8⅛" x 7¼" x 15⅛". Excellent cond. With schematic **$17.95**

DU-1. DIRECTION FINDER LOOP AMPLIFIER for ARB receiver. With tubes and loop. Excellent condition. With schematic $19.95

MS-53 INTERCHANGEABLE MAST SECTIONS. 3 ft. length **69c**

BC-995 SERVO-AMPLIFIER. New, boxed, less tubes **$4.95**

4 V. WET CELL BATTERY. For TBY, New. This is the hot one! **$6.95**

SURVIVAL FLASHLIGHT. Single cell, plastic case, with red plastic face. A car, boat & plane necessity. New. Ea. **19c**

T-26 CHEST SET. With F-1 unit. Overseas pack. Brand new **$1.29**

RS-38 CARBON MIKE. Good condition **$2.75**

BC-367 INTERPHONE AMPLIFIER. New. With 2 spare 6V6's **$12.95**

AIR CORPS TYPE SIGNAL LIGHT. Model K-3. 24V. With amber and purple reflectors & carrying case. Ex. cond. **$4.95**

MARK III MICROPHONE & RECEIVER HEAD GEAR. Brand new, boxed. Only **$3.95**

NEW CATHODE RAY TUBES 5BP1 ..... $1.29
5HP4 ..... 1.69

HS-18 HI IMP. HEAD SET. 10,000 ohms. Less band. New **$1.95**

JENSEN PERI-DYNAMIC ENCLOSURE. For 6" speaker. New, not surplus. Regular $15.00. Special **$2.95**

A HAM'S DREAM!
APX-1 or APX-2 IFF EQUIPMENT. This transceiver is a treasure-house of tube sockets, coaxial fittings, 2 motors, resistors, condensers, microswitches, amphenol conductors, and rafts of other parts. Less tubes. The whole deal **$6.95**

MODEL ABK-7 AIRCRAFT RADIO RECEIVER. Complete less tubes. Good. Great for parts **$6.95**

CRYSTAL CALIBRATED FREQUENCY METER. Model LM-10 or LM-13. Navy model. Freq. range: 125-20,000 Kc. These are un-calibrated. Less calibration book but with crystal. Excel. cond. **$22.95**

SYNCHRONOUS MOTOR. Type 1-4AC. Transmitter or repeater. Made by Bendix. Excellent condition **$19.95**

RECEIVER SPECIALS!

BC-348. Excellent condition $85.00
BC-224. Excellent condition 95.00

MN-26-C. Remote controlled navigational direction finder and communications receiver. Manual DF in any of 3 frequency bands, 150-1,500 Kc. 24 V. self-contained dynamotor supply. With MN-52H and flex cable. A sensational buy! Excellent condition **$19.95**

AN-75 ANTENNA. Expands to 6 ft. **$1.29**

DIRECT CURRENT FAN. 24V. 1,750 rpm. Swell for boat bulkhead. Special **$4.95**

AIRCRAFT HEATER VALVE. ¾" size. 24 VDC. Mfg. by Minneapolis Honeywell. New, boxed **$1.79**

PAPER CAPACITOR. 100,000 mmf, 7,000 W. VDC. New, original box. Only **49c**

MN-52H LOOP INDICATOR. For MN-26. Can be used as multi-purpose indicator. New **$1.49**

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Wide assortment of 24 VDC Motors. Your Choice. New. Each **$2.95**

PE-94B or PE-94C. For SCR-522. Excellent condition. Each 3.95
WE HAVE PE-94 converted to 110 V. To be used as buffer. AC cord attached. Only 4.95

ARC-5/R-28 2 MTR RCVR—2 meter superhet, absolutely one of the BEST available today! Tunes from 100 to 156 mcs. in four crystal channels. (Easily converted to continuous tuning.) Complete with 10 tubes **$17.95**

WILLARD 6-VOLT MIDGET STORAGE BATTERY 3-amp hr. BRAND NEW. 3¾" x 1-13/16" x 2⅜". Uses standard electrolyte **99c**

Command Equipment (274N-ARCS, ATA)

	As Is	Exc. Used
100-550 KC	.....	$14.95
1.5-3 mc	.....	14.95
3-6 mc	5.95	9.95
6-9 mc	5.95	9.95
3—Rec. Rack	.....	1.50
3—Control Head	1.00	2.50

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We have 50,000 amphenol plugs, transmitter and receiver racks, 100,000 transmitter and receiver tubes, rafts of other equipment
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NOTE: All items subject to prior sale and change of price without notice. MINIMUM ORDER: $2.50. 25% deposit with order. Balance C.O.D. All merchandise FOB. Los Angeles, Cal.

R. S. ENTERPRISES
7636 Santa Monica Blvd. Los Angeles 46, Cal.

ing an improved model of its 103LX low-frequency loudspeaker.

The new unit utilizes 4¼ pounds of *Alnico V* magnet. The magnet structure is fully enclosed, thus retaining a heavy concentration of magnetic lines of force within the structure and eliminating losses due to dispersion and stray.

A 35 cps cone resonance is obtained through the use of an extra-large spider assembly and edge damping which permit the straight-sided seamless cone to operate in true piston-like fashion.

The Model 103LX has a power capacity of 25 watts. It measures 8½" x 15¼".

"DYNAURAL" AMPLIFIER

Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass., has released a new "Dynaural" amplifier,

the 210-C, a compact, 23-watt equalizer preamp and power amplifier in a single, compact case.

The amplifier features the "Dynaural" dynamic noise suppressor and record distortion filter which virtually eliminates record scratch and turntable rumble without loss of audible music. The suppressor can be used on all inputs.

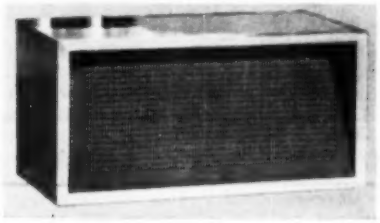
A one-switch, eight-position equalizer provides eight record compensating curves, including the new RIAA curve now being adopted by leading record manufacturers. The compensator operates for either magnetic, crystal, or ceramic cartridge inputs.

A free bulletin on the 210-C is available on request.

PERMOFLUX "DIMINUETTE"

Permoflux Corporation, 4900 W. Grand Ave., Chicago 39, Ill., has recently introduced a compact speaker system which has been tradenamed the "Diminuette."

The system features dual 6-inch drivers and a "super-tweeter." The special



modified bass reflex enclosure increases efficiency in the low frequency range while the cone type tweeter is used for proper tonal balance between the high and low frequencies.

The cabinet measures 23½" wide, 11½" high, and 12" deep. It is available in mahogany or blonde furniture finishes on ¾" birch veneer. A data

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Hughes Field Engineer William H. Scott instructs Air Force personnel in connection with Hughes equipment.

The time was never more opportune than now for becoming associated with the field of advanced electronics. Because of military emphasis this is the most rapidly growing and promising sphere of endeavor for the young electrical engineer or physicist.

Since 1948 Hughes Research and Development Laboratories have been engaged in an expanding program for design, development and manufacture of highly complex radar fire control systems for fighter and interceptor aircraft. This requires Hughes technical advisors in the field to serve companies and military agencies employing the equipment.

As one of these field engineers *you will become familiar with the entire systems* involved, including the most advanced electronic computers. With this advantage you will be ideally situated to broaden your experience and learning more quickly for future application to advanced electronics activity.

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sheet giving full details on this unit is available from the company on request.

THE "COMPACT 12"

Newcomb Audio Products Company of Hollywood, California has recently introduced the "Compact 12," an all-in-one unit combining a 12-watt amplifier, preamplifier, and control unit on a single chassis.

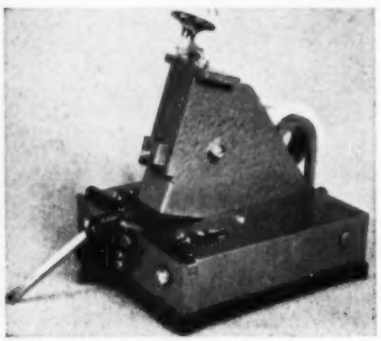
The instrument incorporates separate bass crossover and treble roll-off controls, providing up to 36 different playback curves. An optional rumble filter is also included.

Distortion is below 1% at 12 watts and response is 20 to 20,000 cps ± 1 db. Seven inputs include radio, microphone, high output magnetic pickup, low output magnetic pickup, crystal pickup, tape input, and auxiliary or TV, all of which are easily accessible. The six-position recording curve selector offers the choice of foreign and domestic 78's, *London*, *Columbia*, *RCA*/NARTB,. and AES characteristics.

The "Compact 12" measures 4⅛" high by 12½" by 9". It weighs 9 lbs.

MAGNETIC TAPE SPLICER

F. Reiter Co., 3340 Bonnie Hill Drive, Hollywood 28, California, is now offering a professional, time-saving ¼" magnetic tape splicer which automatically ejects, applies, cuts off, and presses into place the correct amount of splicing tape; hands never touch the splicing tape.



The Model K1 measures 4¾" x 5¼" and comes complete with a roll of splicing tape. The company will supply full details on request.

LONG-PLAYING TAPE

A new long-playing magnetic recording tape which has been tradenamed the "Plus 50" has been announced by *Reeves Soundcraft Corp.*, 10 E. 52nd St., New York 22, N. Y.

The new tape will play 50 per-cent longer than standard tape since each reel will hold 50 per-cent more tape. Thus a 5" reel, which holds 600 feet of standard tape, will hold 900 feet of the new tape which is thinner than standard acetate-base tape. It is made of *DuPont* "Mylar" polyester film.

The "Plus 50" is available on 5" reels (900 ft.); 7" reels (1800 ft.), 10½" reels (3600 ft.) and 3" reels (225 ft.). —30—

For the Record

(*Continued from page 8*)

York, that provide such binaural service. We obtained some excellent tapes on a *Magnecord* PT6BN (binaural 2-channel) with this tuner. We particularly liked the positive tuning of stations on FM. A pair of *Permoflux* "Royal Eights"—spaced to 8 feet—resulted in very pleasing binaural reproduction at normal room volumes. While we personally like the larger speakers and enclosures for monaural we also like the "effect" of the smaller cabinets ("*R-J*," "Largo," "Rebel," "Duette," etc.) for binaural at lower volume levels. That's one advantage of binaural techniques. While on the subject of compactness—be sure to see the new *Scott* 310-FM broadcast monitor tuner. It is very compact, of simple design, and has the famous "Dynaural" noise suppressor built in to squelch interstation noise. A clever tuning bar permits rapid location of any FM channel.

Also seen in considerable number were many excellent preamp-equalizers from which to choose. Printed circuits are getting the nod in such gear, permitting more compactness and insuring more trouble-free performance for crowded circuitry. The trend still continues towards compact amplifiers of approximately 10-watt rating containing their own built-in front ends. The new *Brociner* "Mark 12" is a good example of tuners in this class. Printed circuitry is also being used in several power amplifiers. One of the first was the "Linear Standard Amplifier" designed by *United Transformer Corp.* and marketed in kit form.

Another (FM only) tuner, measuring but four inches in height, is *Fisher's* brand new FM-80, demonstrated to us in a preview just hours ago. We have always liked the symmetry of the *Fisher* equipment and this tuner is no exception. It uses two meters for accurate tuning and for indicating sensitivity. Don't miss seeing this compact gem. A means for correcting (automatically) the mismatch presented to an amplifier by varying impedance characteristics of voice coils on loudspeakers is another interesting development. It is called "Z-Matic" and was designed by George Maerkle of *Fisher*. Its effect is somewhat startling to the audiophile. As soon as circuitry can be revealed we'll pass along the data to the audio technician who can benefit from such knowledge.

The observations reported in this brief commentary are, of necessity, limited to but a few of the many developments that will be announced during the coming weeks. We have not, at this writing, seen all of the many new products that will be unveiled at the audio shows. By the time you read this issue the 1954 audio shows will be over. We'll bring some of the highlights to your attention next month. . . . . O. R.

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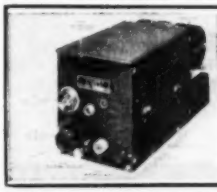

234-258 MC RECEIVER

11-tube UHF tunable receiver with schematic. Like new.

$14.95 Wt. 10 lbs.

Rack $3.50
Control Box..... 1.50

ARB NAVY RECEIVER

105 to 9050 KC. Four Bands, Calibrated Dial. LF-Ship BC—80 & 40 Meter—Complete with Tubes and Dynamotor. For 24 Volt operation; easily converted to 110 V—12 or 6 Volt. Size 8¾" x 7¼" x 15¼". Excellent cond. With schematic, Weight 30 lbs..... **$19.95**

DU-I. DIRECTION FINDER LOOP AMPLIFIER for ARB receiver. With tubes and loop. Excellent condition. With schematic, Wt. 10 lbs..... **$19.95**

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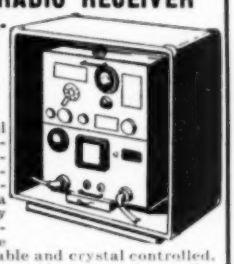

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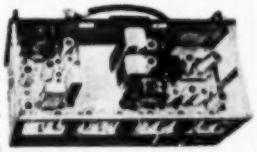
UHF TRANSMITTER-RECEIVER
APS-13
$3.95



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Servicing Amplifiers

(*Continued from page* 61)

volt r.m.s. signal at the first 6SL7 (V_{2A}) grid. The gain in this stage is 18 db, and the signal at the plate should be 2 volts r.m.s. with no visible distortion. The 20-db attenuation in the tone control circuit gives a 0.2-volt r.m.s. signal at the grid of V_{2B}, with still no distortion visible on the oscilloscope. This next stage has a gain of 24 db; therefore, the signal at the grid of the driver tube is 3.2 volts r.m.s.

In observing the output of the driver stage, it is necessary to take into account the effects of the feedback. The rest of the circuit after V_{2B} is within the feedback loop; consequently, the distortion from the output will be introduced into the entire driver-power amplifier section by the feedback connection. It is desirable, therefore, to disconnect the feedback and reduce the level from the signal generator to produce approximately 0.5 volt r.m.s. at the driver grid.

Now, assume that the signal level at the grid of the V_4 power amplifier stage is about 10 volts r.m.s. and undistorted. Further, say that the second power amplifier grid shows clipping of the positive peaks of the signal. Also, when the signals at the plates of the power amplifiers are observed, the waveshape at the V_4 plate shows rounding off of the sine wave on one side—which indicates too much negative bias—while the plate of V_5 shows the grid signal amplified.

To detect the actual cause of the failure in the circuit, it is necessary to use the multimeter to measure voltages with no audio signal applied—using a vacuum-tube voltmeter to avoid loading down of high-impedance circuits when measuring grid voltages. Assume that such measurement shows the grid of V_4 to be at ground potential, the grid of V_5 at +10 volts, and the common cathode connection to be at +17 volts. The cause of the failure is immediately obvious—the leakage resistance of the .05-μfd. coupling condenser from the phase inverter to the grid of V_5 has been reduced to about 10 megohms, putting a positive bias voltage at the grid of V_5 and unbalancing the power amplifier. This has three unfortunate results: (a) too little negative bias is applied to V_5 causing its plate dissipation rating to be exceeded; (b) too much negative bias is applied to V_4 causing it to operate at an improper point on its characteristic, producing distortion; and (c) the d.c. applied through the output transformer is unbalanced, resulting in further distortion due to saturation effects in the iron core.

To correct this condition, the condenser is replaced, and the signals at the plates of V_4 and V_5 are again observed to make certain that they have

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the proper waveshapes. The feedback is then connected again, the input from the signal generator raised to 2 volts, and an over-all measurement is made from input to output. The distortion meter is now used for a more precise measurement to make sure that there are no additional minor unbalances or distortions. If the harmonic distortion is found to be less than 2 per-cent, the amplifier can be considered to be in its original operating condition.

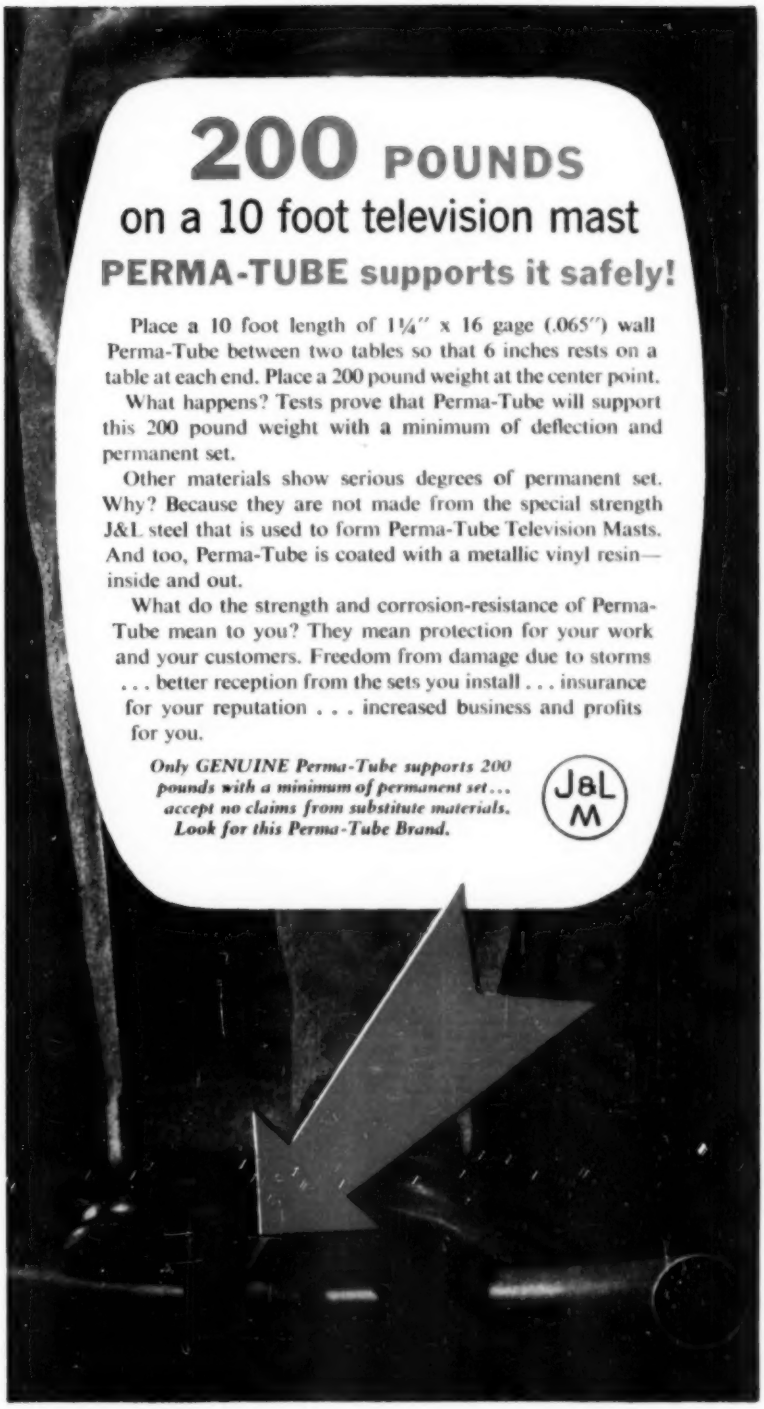
Once the amplifier is repaired, it is desirable to perform several additional tests to insure that the amplifier is operating properly in all respects. Distortion has already been measured, so brief measurements are also made of frequency response with tone controls in the flat and the extreme positions, noise and hum level, and maximum power output for no distortion visible by the oscilloscope.

Several interesting observations can be made about the particular failure we have just described, further illustrating the difference between servicing high-fidelity gear and other types of equipment. Excessive leakage of a plate-to-grid coupling condenser rarely causes trouble in ordinary amplifiers since the current in the tube increases and adjusts the cathode bias to the proper operating voltage. However, in this push-pull amplifier, it is necessary to use a common cathode resistor to maintain proper d.c. balance under normal conditions. Excessive leakage in such circuits results in unbalance.

It should be noted that although the failure appeared at the plate of the V_4 power amplifier tube, it actually occurred at the grid of the V_5 stage; it is often the case that a failure appearing at some point in the circuit is found either in the preceding grid circuit or the following plate circuit. In this particular case, the failure might have been detected more rapidly by starting at the output and working toward the input, but the procedure is so fast that very little time is lost, and it is desirable to have an established routine procedure.

A number of precautions must be taken in servicing high-fidelity amplifiers. Since the amplifier is part of a complete system, careful attention must be given to the source impedance of the signal generator and to the load impedance into which the amplifier is matched. If the audio signal generator does not have the proper impedance, then a resistive impedance-matching network must be inserted between the generator and the amplifier.

When noise level is measured in low-level circuits, the impedance at the input is especially important since the input noise is often developed across this impedance. Signal levels in the circuit must also be carefully considered since any apparent distortion in the circuit may be merely the result of overloading one of the stages by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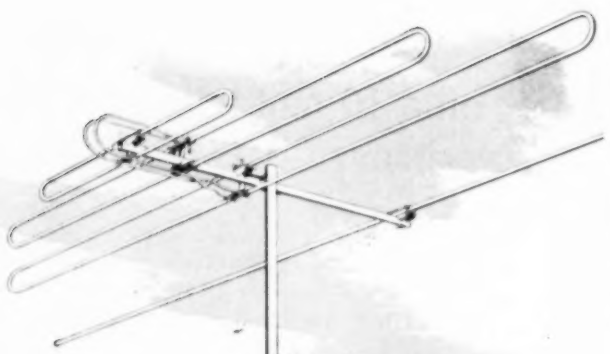

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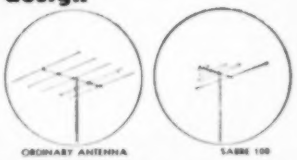

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using too high a level from the signal generator. This is especially important in checking those parts of the circuit which contain frequency-response equalization (such as magnetic pickup preamplifiers and tone-control circuits), since a signal level which does not overload at one frequency may cause overloading at another frequency. Overloading may also cause incorrect output level readings when measuring frequency and amplitude response of equalized circuits.

—30—

Audible Grid Dipper

(*Continued from page* 55)

rifying sounding signal I have ever heard. Cut a piece of light cardboard to fit the case, mark three concentric circles that can be easily read and fasten the cardboard under the retaining nut on the variable condenser shaft. Start on the lowest frequency and work up. Mark the divisions and frequencies lightly with pencil for all five bands. Go slowly and don't pick out any of the harmonics. Remove the dial card and type in the numbers, mark the divisions with ink and when dry erase all the pencil marks. I have five scales on my dial plate: three on the upper half and two on the lower half. The tuning condenser in a unit with a dial like mine must have semi-circular plates and be capable of rotation through 360 degrees.

This grid dipper could be built for operation on 6.3 volt a.c. heaters and any source of plate voltage. There must be a method of varying the plate voltage. I used a series resistor, rather than a voltage divider, to reduce battery drain. Variable plate voltage provides a method of adjusting the sensitivity of the instrument and will help give some indication of the "*Q*" of the circuit under test.

This little unit is actually—as you can see—a receiver type detector and I was surprised to be able to tune in about three or four 75-meter phones when checking the resonant frequency of a center-loaded whip. I don't think it will ever replace the "Super Pro" though.

—30—

EMERGENCY MONITOR REQUEST

ALL amateur radio operators have been asked to listen for signals from 7HTAS, William Willis, who has not been heard from since June 28th as his small raft tosses on the Pacific Ocean's "Kon-Tiki" route.

Mr. Willis, 60, was last contacted when he was six days and several hundred miles from shore. He messaged the Peruvian government on that date that he was OK.

His schedule is daily at 11 a.m. and 6 p.m. EST on an assigned emergency frequency of 8364 kc. He is not allowed to communicate.

The National Company, Malden, Mass. manufacturer of his receiver, asks that any ham hearing his signal contact them by telegraph collect.

—30—

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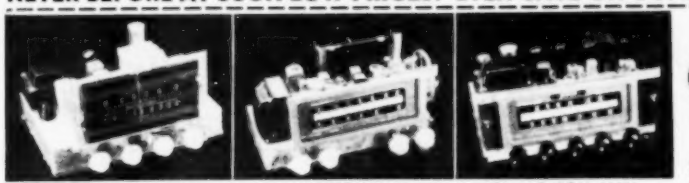

(A) HALLICRAFTERS S-78A (B) JACKSON FA8C (C) JACKSON AM9A

11-TUBE FM-AM HALLICRAFTERS

Regular $89.50

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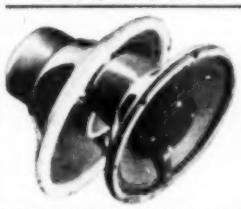
Model FA8C with our CU-14Y 12" coaxial PM speaker, both for $49.95.
Model FA8C with our P15-CR 15" coaxial PM speaker, both for $59.95.



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Garrard "Triumph" Model RC-80, 3 speed automatic record changer. Plays all 3 sizes automatically and shuts off after last record. Heavy duty AC phono motor and weighted turntable gives constant speed. Muting switch silences pickup during change cycle. Complete with two separate plug-in shells for either crystal or G.E. variable reluctance cartridge. Overall size, 13¼" wide, 15½" deep and 6" high. 2½" below motor board and 5¼" above. 105-125 volt, 60 cycle AC. Ship. wt. 20 lbs. Large 45 RPM spindle $3.43 extra. Model RC-80 Garrard changer, less cartridge $68.51. With flip-over crystal cartridge $52.46. With RPX-052 G.E. Golden Treasure ca.tridge $68.51.

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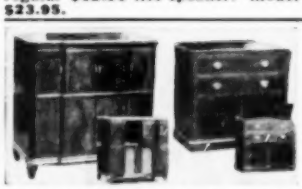

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No. K-275 (left illustration). Walnut radio-phono cabinet 42" h. 42" w. 22" deep. Made for Capehart selling for $900. Radio chassis area 14" h. 11½" w. Changer compartment 14" x 26" w. 12" baffle completely enclosed. Cabinet weighs approx. 175 lbs. Ship. wt. 275 lbs. Sale price $79.95.

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Made for $700.00 Class Capeharts

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R-1758 (right illustration). Walnut radio-phono cabinet 37" h. 40" w. 21" deep. Radio area 14½" wide. Changer compartment 25½" wide. Hinged top lifts in two sections. Baffle for 2 12" speakers. Made for $700 Capehart combination. Ship. wt. 160 lbs. Sale price $59.95.

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(c) No. 21-FDT. 21" full door mahogany. 35" h. 27" w. 22" deep. Chassis area 24" w. 21½" h. 16½" deep. Baffle for 12" speaker. Panel cut for 21" tube. Made for a $395 set by a famous TV factory. Ship. wt. 75 lbs. Sale price $44.95.

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(d) No. 21-OFM. 21" Mahogany open front. 27" h. 25½" w. 20½" deep. Chassis area 24" w. 21½" h. 18¾" deep. Baffle for 10" speaker. Small overall, but plenty big enough for 21" set. Made for a $395 TV set. Ship. wt. 65 lbs. Sale price $29.95.

17" MAHOGANY FULL DOOR CAB. ..$29.95

(e) No. AM-430. Mahogany with full doors. 36" h. 24" w. 21¼" deep. Chassis area 22" w. 17¼" h. 16¾" deep. Blank panel. Holds 17" TV easily. Baffle for 10" speaker. Ship. wt. 60 lbs. On sale at less than it cost a famous TV factory. Sale price, $24.95.

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(f) No. AH-65A. Walnut with half doors. 36" h. 20½" w. 21½" deep. Chassis area 19" w. 15¼" h. 15¾" deep. Blank panel. Will hold most 17" sets. Baffle cut for 10" speaker. Ship. wt. 65 lbs. An attractive well proportioned cabinet on sale at only $29.95.

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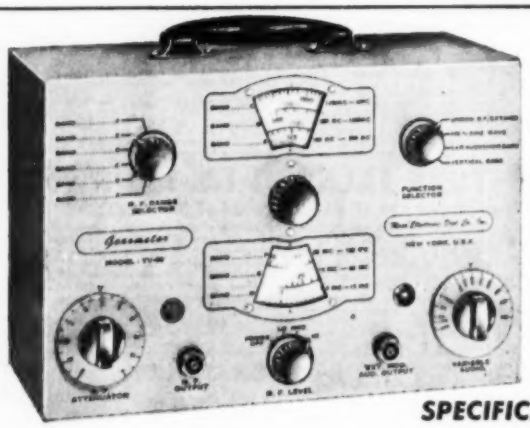

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- ✔ *Audio Frequency Generator*
- ✔ *Bar Generator*
- ✔ *Cross Hatch Generator*
- ✔ *Color Dot Pattern Generator*
- ✔ *Marker Generator*

SPECIFICATIONS:

R. F. SIGNAL GENERATOR:

The Model TV-50 Genometer provides *complete* coverage for A.M. and F.M. alignment. Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 180 Megacycles on powerful harmonics. Accuracy and stability are assured by use of permeability trimmed Hi-Q coils. R.F. is available *separately*, modulated by the fixed *400 cycle sine-wave* audio or modulated by the *variable* 300 cycle to 20,000 cycle variable audio. Provision has also been made for injection of any external modulating source.

VARIABLE AUDIO FREQUENCY GENERATOR:

In addition to a fixed 400 cycle sine-wave audio, the Model TV-50 Genometer provides a variable 300 cycle to 20,000 cycle peaked wave audio signal. This service is used for checking distortion in amplifiers, measuring amplifier gain, trouble shooting hearing aids, etc.

BAR GENERATOR:

This feature of the Model TV-50 Genometer will permit you to throw an actual Bar Pattern on any TV Receiver Screen. Pattern will consist of 4 to 16 horizontal bars or 7 to 20 vertical bars. A Bar Generator is acknowledged to provide the quickest and most efficient way of adjusting TV linearity controls. The Model TV-50 employs a recently improved Bar Generator circuit which assures stable never-shifting vertical and horizontal bars.

CROSS HATCH GENERATOR:

The Model TV-50 Genometer will project a cross-hatch pattern on any TV picture tube. The pattern will consist of non-shifting, horizontal and vertical lines *interlaced* to provide a stable cross-hatch effect. This service is used primarily for correct ion trap positioning and for adjustment of linearity.

DOT PATTERN GENERATOR *(For Color TV)*

Although you will be able to use most of your regular standard equipment for servicing Color TV, the one addition which is a "must" is a Dot Pattern Generator. The Dot Pattern projected on any color TV Receiver tube by the Model TV-50 will enable you to adjust for *proper color convergence*. When all controls and circuits are in proper alignment, the resulting pattern will consist of a sharp white dot pattern on a black background. One or more circuit or control deviations will result in a dot pattern out of convergence, with the blue, red and green dots in overlapping dot patterns.

MARKER GENERATOR:

The Model TV-50 includes *all* the most frequently needed marker points. Because of the ever-changing and ever-increasing number of such points required, we decided against using crystal holders. We instead adjust each marker point against precise laboratory standards. The following markers are provided: 189 Kc., 262.5 Kc., 456 Kc., 600 Kc., 1000 Kc., 1400 Kc., 1600 Kc., 2000 Kc., 2500 Kc., 3579 Kc., 4.5 Mc., 5 Mc., 10.7 Mc. (3579 Kc. is the color burst frequency.)

The Model TV-50 comes absolutely complete with shielded leads and operating instructions. Only

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Measures 6¼" x 9½" x 4½"

Superior's new Model 670-A

SUPER METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts
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OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Good-Bad scale for checking quality of electrolytic condensers)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
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ADDED FEATURE:

Built-in ISOLATION TRANSFORMER reduces possibility of burning out meter through misuse.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions.

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Superior's new Model TV-11

TUBE TESTER

SPECIFICATIONS:

★ Tests all tubes including 4, 5, 6, 7, Octal, Lock-in, Peanut, Bantam, Hearing Aid, Thyratron, Miniatures, Sub-Miniatures, Novals, Sub-minars, Proximity fuse types, etc.
★ Uses the new self-cleaning Lever Action Switches for individual element testing. Because *all elements are numbered according to pin-number in the RMA base numbering system*, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary.
★ The Model TV-11 does not use any combination type sockets. Instead individual sockets are used for each type of tube. Thus *it is impossible to damage a tube by inserting it in the wrong socket.*
★ Free-moving built-in roll chart provides complete data for all tubes.
★ Newly designed Line Voltage Control compensates for variation of any Line Voltage between 105 Volts and 130 Volts.
★ NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRA SERVICE—The Model TV-11 may be used as an extremely sensitive Condenser Leakage Checker. A relaxation type oscillator incorporated in this model will detect leakages even when the frequency is one per minute.

The model TV-11 operates on 105-130 Volt 60 Cycles A.C. Comes housed in a beautiful hand-rubbed oak cabinet complete with portable cover. .....

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SUPERIOR'S NEW MODEL TV-40

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★ **A complete picture tube tester for little more than the price of a "make-shift" adapter!!**

The Model TV-40 is absolutely complete! Self-contained, including built-in power supply, it tests picture tubes in the only practical way to efficiently test such tubes; that is by the use of a separate instrument which is designed exclusively to test the ever increasing number of picture tubes!

EASY TO USE:

Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base *(ion trap need not be on tube)*. Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

★ **Tests *all* magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!!**

SPECIFICATIONS:

- Tests *all* magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Tests for open elements.

Model TV-40 C.R.T. Tube Tester comes absolutely complete—nothing else to buy. Housed in round cornered, molded bakelite case. Only .....

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• TRANSFORMERS AND CIRCUITS •

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New Antenna Standards

(*Continued from page 41*)

tics of an antenna that must be considered in rating an antenna. For the method of rating suggested here, each one of the five is given equal weight. This means, for example, that the horizontal response of an antenna is 20 per-cent of the total rating. Consequently, if an antenna had a perfect horizontal response, it would be rated as 20 per-cent. It is suggested that an antenna with a beamwidth of 10 degrees be considered perfect. Consequently, such an antenna would carry a horizontal response rating of 20 per-cent. A dipole with a beamwidth of 50 degrees would carry a rating of zero per-cent. Any beamwidth between 10 degrees and 50 degrees would be rated accordingly, with each degree below 50 equalling one-half per-cent. Thus, for the antenna whose pattern is Fig. 1C, the difference between its beamwidth and the beamwidth of the dipole is 32 degrees. Since each of these degrees is equal to one-half per-cent of rating, the horizontal response part of its signal-to-noise figure would be 16 per-cent.

Most antenna manufacturers use automatic test equipment for recording the horizontal patterns of their antennas. The antenna under test is located at a minimum of 10 wavelengths from the transmitting source and at least 5 wavelengths above ground. The signal from the test antenna is simultaneously fed to a logarithmic meter and the input of a polar recorder. The turntable of the recorder is selsyn-controlled through the antenna rotator drive mechanism, and after the transmitting level has been set, an automatic rotation of 360 degrees establishes a finished polar pattern. More detailed information on such measurements are found in the April, 1953 issue of RADIO & TELEVISION NEWS.

The front-to-back ratio of an antenna establishes the ability of the system to reject an undesired signal 180 degrees away from the desired signal. Front-to-back ratio is expressed as the forward gain of the antenna (voltage ratio) divided by the gain from the rear, with the resultant converted to db.

In well-designed antenna systems, the gain from the rear of the antenna is less than that of the standard reference folded dipole. The value of front-to-back ratio, as related to signal-to-noise, is that a high front-to-back ratio effectively eliminates one-half of the polar pattern with its accompanying noise factor and interference. Almost equally important is the system's ability to reject unwanted noise from the side.

For purposes of rating the front-to-back and front-to-side rejection of an antenna, it is suggested that a front-to-back voltage ratio of 10 (or 20 db) be accepted as maximum for a full 20 per-cent rating. Assuming, for exam-

ple, that a particular antenna has a forward gain of 4.5 (12.25 db) and a gain from the rear of .631 (−4 db), the front-to-back ratio would be 6.34. Dividing this by 10 and multiplying the resultant by 20 per-cent will give the front-to-back percentage rating of the antenna; in this case, 12.68 per-cent. The same can be done for the front-to-side rating. To obtain a composite figure for front-to-back and front-to-side ratios, simply take an average of both ratings. Say, for example, that the particular antenna under test has a uniform 20-db rejection from the sides. This gives the voltage ratio of 10 for a full 20 per-cent rating. Going one step further, for a single figure representing both front-to-back and front-to-side rejection, we would add 12.68 per-cent to 20 per-cent and divide by 2. This gives 16.34 per-cent.

The average antenna is designed as close as possible to match the average surge impedance of the transmission lines most commonly used. The effect of a mismatch at the antenna terminals is to reduce signal transfer and causes a general degradation of the horizontal pattern. If a mismatch occurs between the transmission line and the antenna, standing waves will be set up in the transmission line with a resultant loss of signal.

The ideal antenna would have a perfectly resistive termination matching the 287-ohm surge impedance of standard transmission lines. This would give a voltage standing-wave ratio (v.s.w.r.) of one. Since this is the minimum that can be attained, it is suggested that this receive the full 20 per-cent rating. A v.s.w.r. of 1.5 should be rated zero per-cent since it represents a severe case of mismatch. For 20 per-centage points, therefore, we have the range from 1 to 1.5 v.s.w.r. Thus, each .025 of v.s.w.r. below 1.5 equals one per-cent. If, for example, a test antenna had an average terminating impedance of 200 ohms for channels 2 through 6, and 400 ohms on channels 7 through 13, we would compute its terminating impedance rating as follows: its v.s.w.r. for channels 2 through 6 equals 287 divided by 200 or 1.44. For channels 7 through 13, the v.s.w.r. equals 400 divided by 287 or 1.4. (The largest value is always the numerator.) The average v.s.w.r. for channels 2 through 13, therefore, is 1.42. The difference between this and 1.5 is .08, which when divided by .025 yields 3.2 per-cent.

Earlier, we referred to gain as a semi-meaningless criterion of antenna comparison. However, forward gain has a great bearing upon over-all performance and has some meaning when considered together with the other performance factors. The forward gain also helps to establish the front-to-back ratio of an antenna. The suggested ideal value for forward gain is 20 db for a 20 per-cent rating. Since the db scale is logarithmic, a direct proportion between the db rating of an antenna and the percentage scale is not possible. However, by converting

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the db gain to voltage ratio, such a proportion is possible. If an antenna, for example, has an average gain of 12.25 db for channels 2 through 13, this can be converted to a 4.25 voltage ratio gain. This figure, divided by 10 and multiplied by 20 per-cent, gives the per-cent rating for this characteristic.

The ability of the antenna to reject fixed noise and interference from above and below is most important. Vertical patterns may be analyzed in a similar manner as for horizontal patterns, and the same techniques may be used for its measurement and rating.

Table 1 summarizes the suggested rating limits for the five basic antenna characteristics. A single rating for any antenna is obtained simply by adding the percentages in each category. —30—

Choosing Your Speaker

(*Continued from page* 40)

Two-way speakers are a step up in the high-fidelity ladder. Additional improvement may be realized, however, by *greater speaker specialization,* through a speaker system composed of two or more separate units working independently of each other, electrically and mechanically. Such a system is usually composed of a woofer for the low frequencies, a mid-range speaker (sometimes called a squawker) for the middle-range frequencies, and a tweeter for the high frequencies. (Fig. 8.) These specialized loudspeakers may be, individually, of considerably restricted range as compared to a single wide-range speaker. Within that restricted range, however, they may be exceedingly efficient. A woofer of the 15" variety may not be of much value above 2500 cps, but in the range from 40 cps to 500 cps may have extremely high output. Likewise, a tweeter may exhibit no response below 3000 cps but have excellent efficiency from 5000 cps up. Such specialization of individual loudspeakers for particular bands is the means of creating the fine hi-fi systems we know today. This breakdown into special purpose speakers such as woofers, mid-range, and tweeters not only allows them to be designed for maximum efficiency in their respective ranges, but allows them to be designed for other important characteristics that differ from one category to the other.

For instance, a woofer diaphragm must be as rigid as possible to withstand large low-frequency excursions. Rigidity is built into the speaker through the use of a heavy and deep cone. Such a structure would not be desirable in wide-range speakers because it would result in poor and narrowly beamed highs. Compromises are made in the case of the wide-range unit so that it may operate fairly well over the whole range, whereas in the case of the woofer only, no compromise with *low* frequency operation is made.

Specialization of the tweeter type of unit has made it possible to develop efficient high-frequency radiation, and over a wide angle, far better than in the case of the general purpose speaker. In discussing the case of the diffusicone type of speaker, the mechanical crossover attempts to uncouple the center area of the cone from the main cone to lighten the moving system for the highs. Of course, such mechanical coupling cannot be 100% perfect and so again the general purpose speaker has been compromised. In specialized tweeters, however, no such problems exist because the diaphragm is small and the entire moving system is as light as possible. Furthermore, the tweeter horns may be designed to give maximum dispersion over a wide angle through the use of special horn expansions. The shapes of the tweeter horns are such as to restrict radiation in the vertical direction, and spread it out in the horizontal direction. This is accomplished by either multicellular type horns, or the newer widely accepted "reciprocating flare" type. (Figs. 1 and 8.)

From this digression we will see that woofers and tweeters (and mid-range speakers), being specialized in design, perform their intended operations more satisfactorily than a single wide-range speaker that must perform all functions. In buying speakers for hi-fi systems, one should therefore be cognizant of the fact that a restricted frequency range listed for a particular speaker does not signify that it is a low-grade speaker. It may, on the contrary, signify that it is an extremely fine specialized loudspeaker for a particular system application. The choice of component speakers of a multi-speaker system will depend upon the degree of complexity one's budget will allow. A simple two-way system may be made of a 12" woofer and a separate tweeter with an electrical crossover network. These components may be selected on two different bases.

If one already has a good wide-range speaker, he may electrically convert it into a woofer, and then add a separate tweeter. Such an operation usually works very well, since a single wide-range speaker is usually more efficient in the low end than in the high end. Therefore we may utilize its low-frequency capabilities and restrict its high-frequency performance, in essence making it a specialized speaker—a woofer. How do we restrict its high-frequency response? The simplest method is to use a high-pass filter connecting a tweeter to the same line feeding the woofer. This filter couples high-frequency energy from the amplifier directly to the tweeter, which will do a much more efficient job of radiating the high frequencies than the wide-range speaker normally could do.

A better way to convert a wide-range speaker to woofer operation is to use a full *"LC"* crossover network. A crossover network is an electrical filtering system which accepts at its input terminal the whole gamut of frequencies, then separates the high

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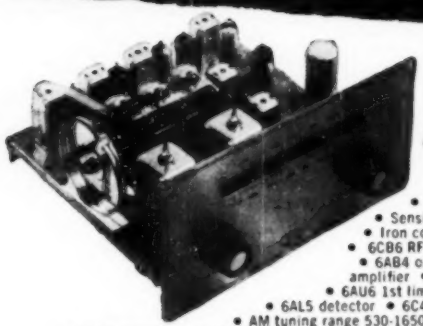

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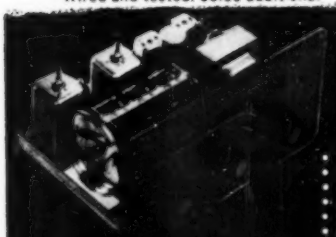

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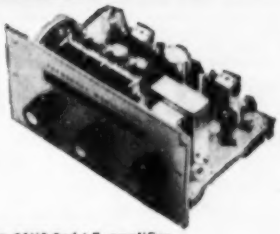

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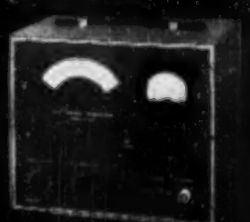

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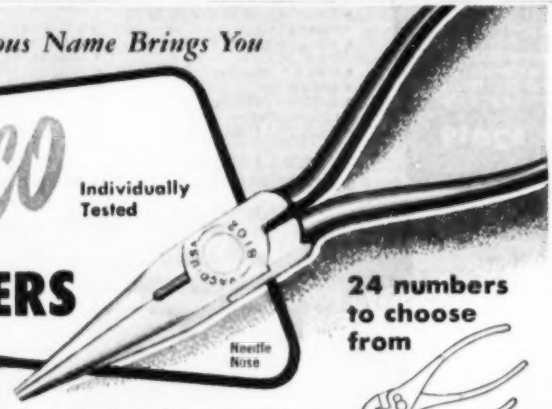

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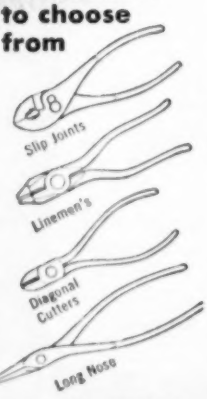

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and low frequencies and retransmits them on separate channels. Such a network will *prevent* high frequencies from getting into the woofer speaker where they would be uselessly burned up, and detours them to the tweeter. The frequency at which the low-high separation takes place is called the crossover point.

The crossover point should be selected so that there is smooth transition of operation from one speaker to the other. The woofer should "roll off" as the tweeter output comes up. (Fig. 9.) If the tweeter cut-off frequency is 2000 cps, the crossover frequency would normally be chosen somewhat higher than this figure to insure that the tweeter is fully operative in the band above the crossover and that damaging low-frequency currents do not enter the tweeter in the range where it is not capable of transmitting sound. Fortunately, there are several types of crossover networks on the market that permit a wide choice of crossover points and impedances. (Fig. 11.) There is also quite a variety of tweeters with different cut-offs from which to choose in composing a system. What cut-off frequency horn should be chosen for a particular application depends upon the woofer system with which it is to be used. If we start with our wide-range speaker (Fig. 9), wherever we choose to cross over we can be reasonably certain that the woofer will have enough energy output to bridge over into the tweeter region. In this case the selection of the proper tweeter is a matter of musical taste. If we cross over at a high point, say 5000 cps, then the large speaker will handle the lows and middle with the normal mellowness of a cone speaker, while the tweeter will give a "horn" crispness and brilliance to the upper middle notes and trebles. If, however, we prefer a more pronounced "presence" effect—the horn-like type of sound projection—in the middle musical tones, then we may select a tweeter that crosses over at 600 cps. The hi-fi enthusiast can play upon his hobby just as much as he pleases *if he plans flexibility* into his equipment. It is for this reason that we stress the point that starting a high-fidelity system with a single wide-range speaker is not a sign of hi-fi weakness, but rather a cornerstone.

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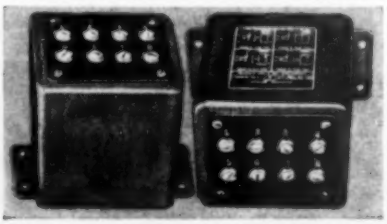
Fig. 11. New multi-impedance, multi-crossover dividing network permitting variety of speaker systems to be used together.



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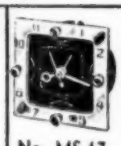

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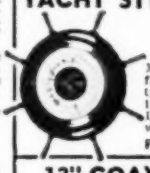

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RE-13	400 MA	1.75	1.68
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MAP MEASURER & COMPASS

- Not a gadget—a real instrument!
- Measures curved or irregular shapes!
- Use on any size map.

Ideal for motorist—camper—hunter—boating enthusiast! Just trace along route and read distance from dial! Built-in Magnetic compass fully calibrated.

F-47.....Net 1.69

A REAL BARGAIN IN CRESCENT, 3 SPEED AUTOMATIC "INTERMIX" RECORD CHANGER

ONLY 19.95

WITH TURNOVER CRYSTAL CARTRIDGE

Famous make latest design, fully automatic changer at record low price! This peerless performer plays all 7", 10" and 12" records in any sequence. "Free floating" featherweight tone arm has Webster turn over cartridge and dual needles for 33⅓, 45 and 78 rpm, balanced for excellent tonal reproduction. Automatic shut off after last record. Direct rim drive turntable action and constant speed motor for "wow" free operation. Easily installed. Will not jam. Dim. 13" x 11½" with 5⅛" clearance required above and 2⅛" below mtg. board. Complete with Phono and AC Cords. Fresh stock. Quantity limited at this low price. Wt. 10 lbs. No. A501.....19.95

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Reg. price ~~$185.00~~* *Our price* **$14.95**

Brand new, in original Western Electric's jeweler's case. Supplied with receiver, receiver cord, battery cord and plug (less batteries). Money back guarantee. Act now while they last! Uses Burgess XX30E and 8R batteries at $1.55 per set.

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- Imported from Germany.
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Magnifies objects 4 times! Not a "drugstore toy". Contain fine optically ground and polished lenses. 40 mm. objective lenses for maximum light gathering power. Complete with neck strap.

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TURNOVER CERAMIC PHONO CARTRIDGE WITH DUAL SAPPHIRE NEEDLES

REPLACEMENT FOR COLUMBIA 360—VM—WEBSTER AND CRESCENT RECORD CHANGERS

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PRECISION DRAFTING SET

11 Pieces—Fitted Felt-Lined Case

$2.75

Made in Germany, of heavy brass, nickel plated and polished. Instruments include 5½" Compass with pencil and pen points and lengthening bar. 5½" Divider, three 3½" sidewheel bow dividers with needle point, pen point and pencil point. 5" Ruling pen, extra handle for pen or pencil, capsule with extra leads. Interchangeability of these many parts makes this an exceptionally versatile set. Your money back—if this set is not worth twice our price!

F-13.....Net 2.75

SPEEDWAY ¼" DRILL

Powerful, lightweight drill, for home or shop. Capacity: ¼" in steel, ⅜" in hard wood. Speed at full load: 1,500 r.p.m. Heavy duty trigger switch with "lock" and instant release. With Jacobs geared key chuck. For 115 volts AC-DC. Shpg. Wt. 4 lbs.

HD-108 Speedway ¼" Drill.....Net 14.29

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WAS ~~36.75~~

SPECIAL

17.45

Typical Lafayette Value. Made by leading manufacturer. Operates from 110 VAC and supplies 6 volt DC up to 10 amps continuous, 15 amps intermittent. 9-Position switch adjusts output for any drain from ½ amp up. As battery charger delivers approx. 8 amps tapering to 2.5 amps; lower rates obtained from other taps. Has separate voltmeter and ammeter. Size 8¼ x 7¼ x 7". Metal Cabinet. Shpg. Wt. 16 lbs.

Phono Cartridges

3.5 volt output

Guaranteed high quality exact duplicates for direct replacement of all standard cartridges such as L70, L82, L92, W80H, N10, and many others. Pin plug connectors for all 78 r.p.m.

LIST PRICE $5.50

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SPECIAL

Plays 33⅓, 45 and 78 RPM records. Quiet dependable operation assured by rubber shock-mounted friction type motor. Speed change control permits instantaneous meshing of proper idler for desired speed. Shpg. Wt. 3½ lbs. List Price $10.95.

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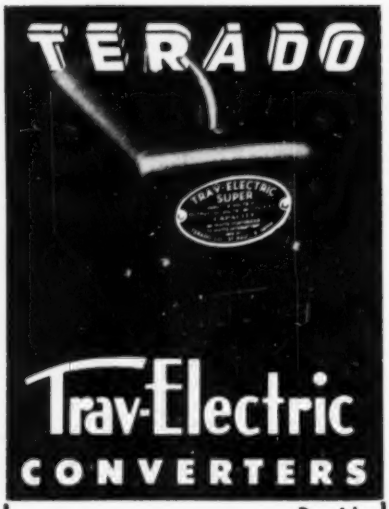
BOSTON, MASS.	110 Federal St.



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CONVERTERS

Provide
House Current Anywhere

—from battery in car, truck, boat. At the beach—picnic grounds—at cabin—on trips —anywhere!

Easy! No installation! Just plug Trav-Electric into cigar lighter on dash.

Trav-Electric Operates:

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- Electric Shavers
- Radios
- Soldering Irons
- Dictating Machines
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- Portable Phonographs
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6 Models—10 to 100 Watts
—a size for every need

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Model 6-11160
10-15 Watts
About as small as a pack of cigarettes
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Model 6-110
115 Cycle—30-40 Watts
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Size 2½" x 2½" x 4½"
35-40 Watts
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40-50 Watts
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ELECTRIC SHAVER

"SUPER"
Model 6-71160
(Shown at top of ad)
60-75 Watts
Size 4" x 5" x 6"
$37.95 LIST

—and now, the "CHIEF"
New—just out—Model 6-81160—75-100 Watts—automatic on-off switch—
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Cable Address—Harsheel

it is possible to go higher up the ladder by starting off with a good high-efficiency 12" or 15" woofer and a tweeter whose horn cut-off is *compatible* with the roll-off rate of the woofer for high frequencies. It would be unwise to buy a 15" woofer that gave exceptionally good low-frequency output, but rolled off at 1000 cps, to be used with a tweeter whose cut off was 3000 cps. (Fig. 10.) There would be a hole of silence between 1000 and 3000 cps where the most of the "presence" of the music exists. If we were committed to a two-way system, we would choose a woofer with a higher roll-off, or a tweeter with a lower cut-off, so that the two would blend together properly.

We may, of course, expect even better performance from a three-way system than from a two-way system. Each speaker would be called upon to operate in a more restricted range than in the two-way system, and consequently would be able to operate more efficiently *within that restricted range*. There would be less intermodulation distortion throughout the band because the band would be broken up into three completely independent channels.

In planning a three-way system we can start with the general purpose speaker and the tweeter and add a hi-fi woofer to the low end. (Fig. 12.) The original general-purpose speaker becomes a mid-range speaker. Of course, a suitable three-way crossover network would be necessary to distribute properly the various component frequencies into the three separate channels.

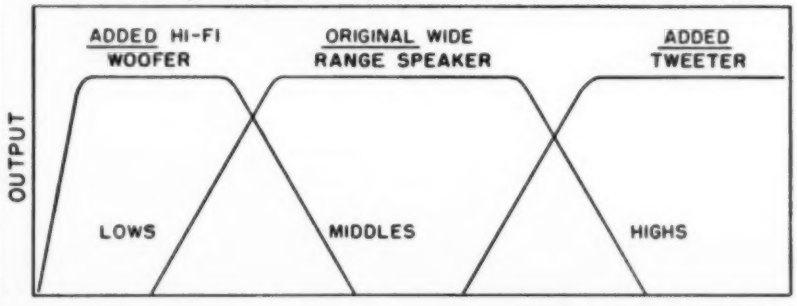
If the hi-fi assembler decides to go all out at once to build the best, he will select his specialized speakers to form a completely compatible system. He will choose a high-efficiency woofer designed *for woofer operation*, a high-efficiency *mid-range speaker*, and the necessary *tweeter*. We suggest for the mid-range speaker a horn type (Fig. 8) for maximum "presence" and "liveness." Horns project out into the listening area with a realism that enhances music reproduction and brings the performing artist to "front and center."

In purchasing equipment for three-way systems, care has to be exercised that the components have cut-off frequencies compatible with each other so that there are no holes in the response between them. Also all the units must be of high efficiency. *The system must be balanced in loudness throughout the range*, otherwise lopsided listening characteristics will result. For example, we may buy a fine high efficiency horn projector for the middles, but a poor 15" speaker of the economy type which is restricted in magnet weight. Such an arrangement would not give enough lows to properly balance the middles and highs. It would be possible to use these components, in a manner of speaking, by reducing the signal input to the middle-range speaker. Such operation, although agreeable, wastes audio power. Furthermore, it will usually be found that a loudspeaker of low efficiency is deficient in other important respects such as damping and transient response. It is best to *build up* to the best component rather than to degrade a good component to match an inferior one.

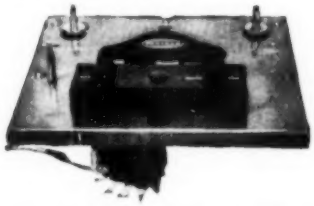
There are certain advantages in having available component parts from which to construct one's own hi-fi system. We can use this man's woofer and that man's tweeter, if our ear tells us that is what we like. Or if we are not sure of what we like, we can start small, and expand as we become more deeply indoctrinated in the art. Yes, there are advantages, but there are pitfalls too, those of matching components, wiring, mounting, and selection. The selection of speaker components may be greatly simplified if the prospective buyer will be satisfied with engineered packaged units. He will have no worries about which tweeter to put with which woofer if he will accept the manufacturer's integrated two-way or three-way speakers *already assembled into one unit* ready for mounting in a cabinet. These speakers are usually of the coaxial type where both electrical and mechanical crossovers are employed. With integrated units, as compared to systems of matched separate units, the enclosure problem is greatly simplified. The enclosure problem becomes paramount as soon as the choice between an integrated unit and a distributed multi-speaker system is made, which logically brings us to the next step in the acoustic chain after the loudspeaker, namely, the enclosure.

(To be continued)

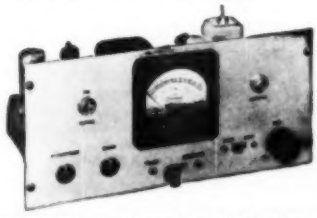
Fig. 12. A hi-fi three-way system may be constructed using one's original wide-range speaker as the mid-range speaker and adding a hi-fi woofer onto the low end and a tweeter at the high end by means of proper crossover networks. See details in text.



PENTRON High Fidelity Tape Recorder, 3 speakers, dual speed, dual track. Fast forward, fast rewind. Separate record and erase heads. Complete with mike. Shpg. Wgt. 37 lbs. Model HT-225. Net $168.75



PENTRON Tape Recording Mechanism for Custom Installations. Dual speed, dual track heads. Shaded four pole self-starting induction motor, balanced. For use with HFP-1 preamp. Shpg. Wgt. 26 lbs. Model 9T-3M. Net $59.75

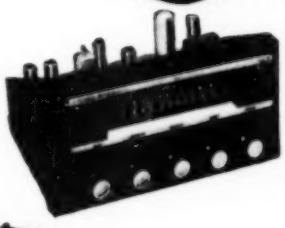


PENTRON Deluxe Preamplifier. Wide frequency response (50-12,000 CPS 3 DB). Fully wired, ready to plug into any Hi-Fi system. Illuminated VU recording meter. 5 tubes. Companion unit to 9T-3M recording mechanism. Shpg. Wgt. 6 lbs. Model HFP-1. Net $59.75

GOOD NEWS FOR YOU!

In keeping with our policy as the house of "Surprise" trade-ins, Walter Ashe will now accept your used, factory-built communications receiver, transmitter or test equipment towards the purchase of any Hi-Fi gear which we carry.

However, we do not trade in used Hi-Fi equipment.



The Radio Craftsmen "Assembly"

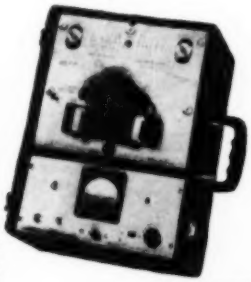
High fidelity home music system. Consists of 4 units listed below. All units except record changer are available separately. Complete system in one carton. Approx. Shpg. Wgt. 80 lbs. Net $275.00

C-30 RECORD CHANGER. 3 speeds, all size records. 4-Pole quiet motor. Automatic shut-off. With GE reluctance "Triple-Play" cartridge. Chrome plated base. Not available separately.

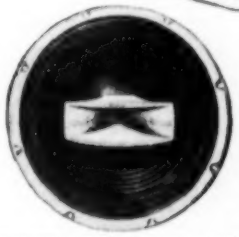
C-10 AM-FM TUNER. Built-in phono preamp. 20-20,000 CPS response. 11 tubes plus rectifier. Polished chromium chassis. Tuner only. Net $131.50

C-400 HI-FI AMPLIFIER. 15-20,000 CPS response. PP 6V6GT output stage. Polished chromium chassis. Amplifier only. Net $42.90

C-20 HI-FI SPEAKER. 40-16,000 CPS response. Has 12" woofer, horn loaded tweeter with wide angle dispersion. 2000 CPS crossover. Speaker only. Net $49.50



PENTRON tape mechanism and preamplifier mounted in specially built carrying case. Consists of 9T-3M and HFP-1. Model PMD-1. Net $134.50



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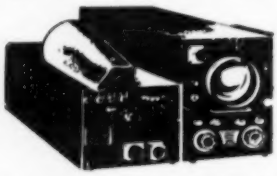
LORAN
FINE QUALITY NAVIGATIONAL EQUIPMENT



Marine or Airborne LOng RAnge Navigational equipment! Determine the exact geographic position of your boat or airplane!

The LORAN system enables a navigator to determine the exact position of his craft accurately and quickly. The accuracy of the system and the speed at which readings may be taken and interpreted make the system particularly useful in any transoceanic boat or airplane. The complete LORAN system is made up of internationally located ground stations which provide a special radio signal pattern solely for LORAN usage. The AN/APN-4 system receives these signals and translates them into information useful to the navigator. Accurate geographic positions may be located up to 1200 miles from any LORAN transmitting facility. Complete installation weighs less than 100 pounds. Accurate and dependable navigation available 24 hours per day!

For the FIRST TIME ... LATEST "B" MODEL complete BRAND NEW installations.

Consisting of:
- **ID-6B/APN-4 Indicator**
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- **Set of PLUGS**
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$129.50 Complete as Described

EXPORTERS AND FLEET OPERATORS: We solicit your inquiries for this and like equipments.

R-65/APN-9 LORAN Indicator. LATEST MODEL UNIT. Complete in one light weight case. Accurate on a maximum range of up to 1600 statute miles, within 1% of the distance from the ground transmitter. The finest unit available at any price! BRAND NEW.

Only..... **295.00**

ID-6A/APN-4 LORAN Indicator. Uses 5CP1 Cathode Ray Tube. Easily converted to test oscilloscope, panadapter, analyzer, visual counter, etc. Contains extremely accurate 100 KC crystal to time sweeps and marker pips at 2, 20, and 100 KC or 50, 500, and 2500 microseconds. Two parallel sweeps, time differences between signals, between half power points on passband curves, and numerous other scope uses. Use the counter circuits for FM demodulation, or to time camera shutters, etc. Double deck chassis, 5CP1 mounted in full tube shield, lots of octal sockets (used 25 tubes). Plenty of room to build on any scope circuits you can dream up. Contains 22 pots, loads of switches, condensers, transformers, small parts. Less small tubes, COMPLETE with 5CP1, Crystal, and schematic in cabinet 19½" x 9" x 11¼". BRAND NEW! While they last. **$18.95**

R-9A/APN-4. 160-meter LORAN Receiver, plus high voltage for scope and low voltage power supply. Three channels tunable from 1.6 to 3.3 MC, one channel tunable 7.58 to 11.75 MC. The power supply delivers 240-275 volts continuously variable at 150 ma electronically regulated to ± .01%, 1450 vdc above ground at 1.2 ma, 1250 vdc at 1.2 ma below ground. With schematic and instructions for 60 cycle operation. BRAND NEW, less tubes..... **$9.95**

6B4G—6H6 or 6SK7 NEW.....49¢ EA.
5CP1 BRAND NEW.....4.95 EA.
100 KC crystal NEW.....4.95 EA.

2430 S. Michigan Ave.
CHICAGO 16, ILLINOIS
CAlumet 5-1281

R.W. ELECTRONICS

WHAT'S *New in Radio*

The products described in this column are for your convenience in keeping up-to-date on the new equipment being offered by manufacturers. For more complete information on any of these products, write direct to the company involved.

BATTERY ELIMINATOR

D. W. Thomas Engineering, Inc., 1820 W. 54th Street, Los Angeles, California, is in production on a battery elimina-

tor, the Model 1400, which is designed to be used with its new tube and vibrator tester, Model 1402.

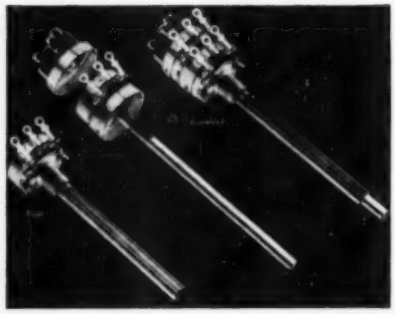
The battery eliminator is powered by 117 volts, 60 cycles for bench testing of all types of automobile radio sets and contains a variable transformer so that the voltage output is continuously variable from 0 to 15 volts at 10 amperes. In addition, this unit contains a "B" supply of 300 volts at 80 ma. and a speaker and cords so that automobile sets which are divided into two sections, one section containing the speaker and vibrapack, can be checked.

DUAL CONTROLS

Centralab, Division of *Globe-Union, Inc.*, 900 E. Keefe Ave., Milwaukee 1, Wisconsin, has recently introduced its new "Fastatch" system of dual-concentric control replacement which eliminates the problems of finding a special control.

The company has separated the rear unit, complete with inner shaft from the front unit, complete with outer shaft, so that shafts can be cut to the proper length and then the units snapped together in one motion.

The number of controls in the new system is limited to the differences in



resistance and taper, a total of 61 fronts and 65 rears, instead of more than 500 "custom" units. These 126 controls make possible 4000 combinations which will handle any carbon dual replacement in present model TV sets as well as future color and black-and-white sets.

A booklet, 42-218, is available from Dept. G-10 of the company.

"4 TOOLS IN 1"

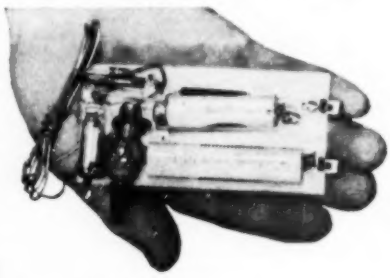
Albert J. Tatu, Inc., 85 Columbia Drive, Williamsville 21, N. Y., is now offering a new model of its inexpensive "4 Tools in 1" unit for radio service shops.

The compact unit punches, forms, shears, and rivets. The new model has been increased in size with the throat depth increased to 1". In addition, a separate threading attachment for use with this tool is now available. The threading attachment will handle ⅛", 5/32", and 3/16" stock.

OSCILLATOR-RADIO KIT

Ekeradio, 646 N. Fair Oaks Ave., Pasadena, California, is currently introducing a subminiature oscillator-radio kit which weighs only 4 ounces with batteries.

The new unit can be used as a radio receiver, tuning the broadcast band, or



as a wireless phonograph oscillator. The kit is moderately priced.

Further information on this particular item can be obtained from the company direct.

INSULATING COMPOUND

A tough, high-dielectric strength, dipping compound for insulating and protecting tools and equipment has been announced by the *Insl-X Sales Co.*, 26 Rittenhouse Square, Ardmore, Pa.

The new E-33 compound completely eliminates the need for taping tool handles or purchasing tools already equipped with non-conductor handles. The compound may be reinforced and built up to practically any dielectric strength desired. Since the compound is chemically inert, it will not corrode or injure any equipment to which it is applied, nor will it be damaged by exposure to oils, greases, ordinary acids, or alkalis.

LOOK WHAT YOU GET FOR $14.95

- 350 feet of continuous length of 50 ohm coaxial cable ..... **$9.50** per length
- 100 feet of same coaxial cable..**$2.00** per length
- Cavity type attenuator..... **$3.95** ea.
- 6 Short lengths of RG8U with connectors and sockets ..... **$ .69** per length
- In wooden case—shipping weight 30 lbs.—all for..... **$14.95**

RCA TV SWEEP GENERATOR

WR-59A, used, Exc. **$89.50**

AT4/ARN-1 ANTENNA

Brand New. Exch..... **$9.95**

MOTOROLA REC., XMTR., and POWER SUPPLY. Type T-69-20, 30 to 40 Mc, AM, 6VDC. Used, good, less tubes..... **$29.50**

RL42 BEAM ROTATOR

Used, good—**$1.95** ea.....3 for **$4.25**

GN-38B Generator for EE8, etc., brand new **$3.95**

BC-1033, 68-77 Mc, RECEIVER, used, exc, less tubes **$5.95**

3" DUAL SCALE PANEL METER

0-1 KV and 0-10MA **$3.95**

PE-110 POWER SUPPLY

110 VAC, for BC-669, used exc. **$29.50**

CD-515 and 513 **CORDS FOR ABOVE**.....ea. **$2.50**

SURPRISE PACKAGE

20 lbs. of MISCELLANEOUS ELECTRONIC EQUIPMENT—WORTH MUCH MORE THAN ONLY..... **$1.95**

BC-611 — WALKIE-TALKIE-CHASSIS, complete, but less tubes, outer case, and speakers, BRAND NEW **$24.95**

OIL CONDENSERS

8 mfd @ 600 VDC.....ea. **$0.98**
.2 @ 4000.....ea. **.98**
10 for.....**$8.95**

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6B4	954	1F4	6H6
6H6	957	1F5	1632
7193-	955	1625	1633
12SJ7	9006	1626	33
1S4	9002	1629	6J6
6AK5	12SQ7	6F8	9004

SPECIAL TUBES

5R4GY .....95c VR150 .....95c
6L6 (1614)....95c 371B 95c
720BY $9.95

TUBE BARGAIN

5AP1 5FP7 } **$2.95 each**
5BP1 4AP10 } **4 for $10.00**
3FP7 3CP1 }

5CP1. New .....**$4.95** ea.

WIRE

Cotton covered, No. 22, solid enameled 1000 ft. **$1.59**

12 V DYNAMOTOR

Output 440V, 400 MA, BRAND NEW **$14.95**

CONTROL BOX

With 0-150V AC Meter, Toggle Switches, etc. BRAND NEW..... **$2.95**

BC-347 INTER-PHONE

Amp. used, **95c** less tubes.....3 for **$2.00**

I-70 "S" METER

New **89c**

ALL ITEMS F.O.B. CHICAGO

25% Deposit required with orders

160 METER RECEIVER

High Voltage Power Supply; can be easily converted for 110 VAC, 60 cycle operation, complete with instructions, brand new, less tubes. **$9.95 each**

VHF RECEIVER

6 tubes: 3—6SL7, 1—6SN7, 1—6H6T, 1—6J5. Dynamotor, plug-in coils and sensitive relays. This was one of the Army's "Secret" V.H.F. remote control receivers. Operating at about 110 MC. A thousand and one uses. New in a metal case. Each **$5.95**

BC 1267 Transmitter & Receiver

154-186 mcs. 1 kw pulse oscillator superhet circuit. Can be easily converted to 2 meter converter and outboard amplifier. Used, exc. cond. ea. **$14.95**

RA-105 POWER SUPPLY

115 V. 60 cyc. input. Output ranges from 110 V. to 2400 V. Consists of 4 transformers, 2 chokes, 7 oil-filled filter condensers & hundreds of other useful items. Parts alone worth $75.00. BRAND NEW. Special at only..... **$13.95**
(Wt. Approx. 100 lbs.)

BC 1267 & RA 105 both for only.....**$25.00**

AN/APR5—An Airborne superhet radar search rec. Freq. range 1000 to 3000 MC. Rec. has a 10 MC IF band width operating from 80-115 VAC, single phase 60 to 2000 cps, and one amp at 26 VDC. Complete with tubes **$250.00**

COMMAND EQUIPMENT
(274N-ARC5, ATA)

	As Is	Excellent
190-550 KC.....	$7.95	$14.95
3-6 mc	5.95	9.95
6-9 mc	5.95	9.95
3-Rec. Rack	.....	1.50
BC 458 Transmitter	4.95	6.95
459 Transmitter	7.95	12.95
456 Modulator	1.95	3.95

Remote Control box and shaft for above, per set..$2.50

ARC-5/R-28 2 MTR RCVR

2 meter superhet, absolutely one of the BEST available today! Tunes from 100 to 156 mcs. in four crystal channels. (Easily converted to continuous tuning.) Complete with 10 tubes. Excellent **$15.95**

T-23/ARC-5 Transmitter. 100-156 MC. complete with tubes. Used. Exc. **$29.95**

WOBULATOR BUILD TV-FM-AM SWEEP GENERATOR

You can build "Versatile Sweep Frequency Generator" with APN-1 magnetic units. With instructions **$5.95**

AN/APT3 Transmitter—operates over a freq. of 300 to 1400 MC; output 30 Watts. The carrier freq. is noise-modulated with effective random noise freq. up to 2 MC. Complete with tubes **$39.50**

I-122 Signal Generator RF signal 15 to 25 MC and 90 to 125 MC; modulated at 400 cps. or 625 cps. Power supply 100 to 135 VAC, 25 to 60 cps. NEW **$39.50**

T-26 Telephone chest unit with F-1 Western Electric Transmitter **$2.39**

TG-34A Portable KEYER 115 or 230 v; 50 to 60 cycle, complete with tubes, photocell and carrying case. Used, only **$14.95**
As is **$7.95**

	Input	Output	Price
D-2	14V	375@150 MA	$7.95
DM-32A	28V@1.1	250@60 MA, ...used	2.95
		new	7.50
D-101	27V@1.75	285VC-.075 amps. ..	1.95
		3 for	5.00

Carlson Stromberg Chest Mike—New.....**$1.29** ea.

CRYSTALS

100 assorted; FT 241, FT 243, DC 34, DC 35.....per 100 **$14.95**
BC654 Transceiver 3800-5800 KC.....Exc. **$39.95**
PE103 Excellent **$24.50**
PE104 Vibrator Supply **$9.95**
ASB RECEIVER: Freq. range: 510-555 MC. With tubes. New. Reduced to..... **$9.95**
ASB TRANSMITTER: Freq. range: 510-555 MC. Complete with tubes. Only..... **4.95**
ASB POWER SUPPLY: New..... **4.95**
ASB ANTENNA SWITCHING UNIT. New Hot buy! **2.95**

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2 METER OUTBOARD AMPLIFIER—Easily converted to 2 meters—Used—Excellent, complete with conversion instructions .....ea. **$3.95**
RT-34 APS-13 TRANSCEIVER—Used as a tail warning radar on **415 MC**. Containing a 30 MC IF strip and various other parts, these units have been stripped of RF sections and all tubes, but are an excellent buy if only for parts and IF strip. Used .....ea. **$3.95**
R-1/ARR-1—220 Mc converted with minor alterations becomes a high gain converter with two stages of RF amplification—complete with diagram). New .....ea. **$3.95**
BC 1033, 75 Mc RECEIVER, less tubes, ea. **$3.95**
4 for $10.00

MOBILE HEAVY DUTY DYNAMOTOR: 14 V. INPUT-output: 1030 VDC 200 MA. Tapped 515 V. 215 MA. use or 6 V DC INPUT—500 V. 175 MA. While they last—DM-42—Excel. Cond. **$9.95**
New **$14.95**

NAVY ARB RECEIVER

195 KC thru 9 Mc. Includes broadcast band. Can be converted easily to a good ham receiver. 28V. DC input. Covers 4 bands. This is a deluxe type super-het receiver. Note: The frequency coverage includes the standard broadcast band. Has 4 gang tuning condenser; can be converted to 110 V. AC receiver. Complete with tubes: 12SF7, 12SA7, 3—12SF7 and 12A6. Dial is built on front of chassis. Electric driven or manual band change switch. Weight 28 lbs.....Excellent **$19.95**
Size 6"x7"x15". Complete with tubes and dynamotor .....Like New **$29.95**

BROADCAST BAND and AERO

Ideal for Use in Boats, etc.

MN-26-C Remote Controlled Navigational Direction finder and communications receiver. Manual DF in any one of three freq. bands, 150 to 1500 KC. 24 V. Self contained dynamotor supply. Complete installation, including receiver, control box, loop, azimuth control. Left-Right Indicator, plugs, loop transmission line and flex. shafts, oper. & main manual

ALL UNITS BRAND NEW EXCEPT CONTROL BOX **$69.50**
MN-26-Y 150 to 325 KC, 325 to 695 KC, 3.4 to 7 megacycles, comp. installation..... 49.50
MN-20-E Loop. Brand New..... 6.95
MN-52 Crank drive. New 2.50
MN-26I.B Receiver exc. freq. 150-1250 KC. 2.9-6mc. **$39.50**

RM29. For field phone use includes talk, listen and ringing crkts. Wonderful sub. for EE8 less handsets —new **$6.95**

Mikes, Headsets & Microphones

T-26 Telephone chest unit with F-1 Western Electric Transmitter **$2.39**

HS-33 Low Impedance Headset exc. **$2.95** .....new **$5.45**
HS-23 Headset, used **$1.89** new **4.50**
CD-307 Ext. cord for HS-23-33 Like new **$.79**.....new **1.29**
Throat Mike—T-30.....new **.98**
Lip Mike—Navy Type .....new **.98**
CW-49505 High Impedance Headset Complete with headband.....Used **98c**
T-45 Lip Mike. New..... **$1.75**
HS-30 miniature headset. Used **$1.49**, new **2.49**
RS38 Navy type carbon mike—exc. .....ea. **$2.95**
4 for **$12.00**

ALTIMETER INDICATOR

Basic movement 0-1 m.a. 5 m.a. shunt 270° scale. An excellent basic G.E. movement for constructing your own meters N-1..... **$1.95**
Receiver—85 to 1000 Mc—Used, Good..... **$69.50**
Radar Indicator and Shield—Complete with 3BP1, 7-6SN7, 1-2X2, 1-6X5. Brand New **$9.95**
Tuning Units—TU-26 and TU-10. Used, exc. **$2.25** ea.
BC-906 Absorption type Freq. Meter, 150-225 Mc. Used, Exc. **$11.95**

BROADCAST BAND RECEIVER

Navy ADF Receiver DZ-1, made by RCA. Continuous 15 to 1750 kc in 6 bands, gear train tuning with vernier and coarse scales, broad or sharp band pass, CW or MCW. All controls on front panel. No headaches of mechanical or electrical control interconnections. Beautifully built with 5 gang tuning capacitor, shielded tubes and coils. 8 tubes: 2—6B6, 2—76, 2—6C6, 1—41. Complete with tubes, less power supply. In excellent condition. Special introductory price only..... **$24.95**
VTVM—Electronic design model 100, used, exc. **$19.95**

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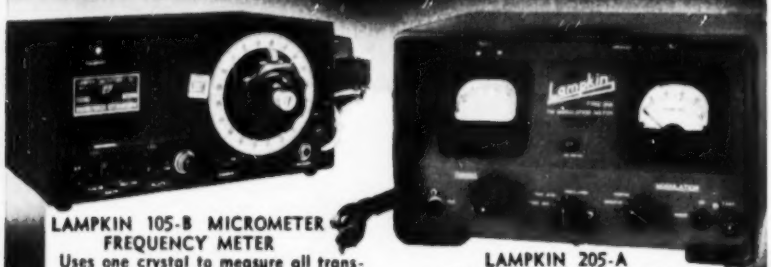

LAMPKIN 105-B MICROMETER FREQUENCY METER
Uses one crystal to measure all transmitters from 0.1 to 175 mc., and crystal-controlled transmitters to 500 mc. Gives readings of percent error from assigned frequencies. Acts as precision CW signal generator for receiver final alignment. $220.00.

PORTABLE—Width less than 13"... weight less than 14 lbs., each.

MEET FCC REQUIREMENTS — for mobile-service checks.

For technical data, mail coupon today!

LAMPKIN 205-A FM MODULATION METER
Direct indication of peak voice deviation, 0-25 kc positive or negative. Tunable 25-500 mc. in one band. Doubles as relative field-strength meter. Built-in speaker. Jack for oscilloscope. $240.00.

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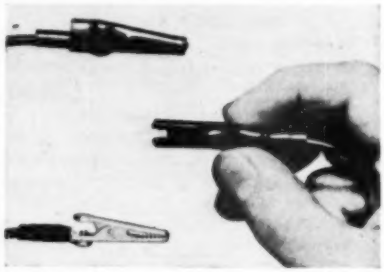
Complete information is provided in Bulletin E-33 which is available from the company upon letterhead request.

INSULATED ALLIGATOR CLIPS

Mueller Electric Co., 1583H E. 31st Street, Cleveland 14, Ohio, is in production on a new insulated alligator clip for applications in crowded and subminiature chassis.

The newly developed insulator adds negligible size to the 15/64" o.d. clip and covers it right down to the tip. A



special lip-action slot in the flexing insulator allows the clip to bite the connection.

Two alligator clip types are currently available. One is cadmium plated steel and the other is solid copper with a brass screw connection. Each type is available with either red or black insulators.

For complete descriptive matter and a free sample, write on company letterhead to the firm.

AMATEUR BEAMS

Mosley Electronics, Inc., 8622 St. Charles Rock Rd., St. Louis 14, Mo., is now offering a new line of "Vest Pocket Beam" antennas, intended primarily for amateur use.

The new series includes both 2-element and 3-element 20-meter arrays and a 2-element model for operation in the 40-meter band. The small size of these new antennas is made possible by the use of a unique loading coil at the center of each element. These coils, of high "Q" design, are spacewound on polystyrene rods and have acrylic weatherproof outer covers. All antennas are designed for 52 ohm impedance feeders.

Full details on this line are available from the manufacturer.

NEW RAYTHEON DIODES

Raytheon Manufacturing Company's Receiving Tube Division, Newton 58, Mass., has added four new silicon diodes, four gold bonded diodes, and a new special-purpose CK6485 to its industrial line.

The silicon units, CK735, CK736, CK738, and CK746, are junction types which are suitable for circuits requiring a diode of high back resistance at elevated temperatures and a high ratio of back-to-forward resistance.

The gold bonded junction germanium diodes, CK740, CK741, CK745, and CK747, are designed for computer applications requiring a diode of high forward current and a high ratio of back-to-forward resistance.

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- AN EASILY BUILT "BLACK LIGHT" SOURCE
- WIDTH CONTROL ADJUSTMENTS IN TV RECEIVERS
- POWER FAILURE ALARM
- THE ELECTRIC EYE—HOW IT WORKS
- BUILD THIS PLUG-IN ABSORPTION WAVEMETER
- TIMING RELAY EXPERIMENTS
- USING AND UNDERSTANDING THE NEON GLOW LAMP
- CHECKING AND CHANGING PHONOGRAPH PICKUP UNITS
- AN ALL-WAVE RECEIVER KIT

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TUNE IN ON THESE TUNING UNITS!
BC-375: T1-7 .8 .9-.10. Excel. cond. **$2.95**
TU-6: Freq. 3,000-4,500 Kc. Excel. cond.....**3.50**
TU-26: 200-500 Kc. Excel. cond.....**3.50**

TV AUDIO & IF STRIP. Complete! New! **$2.95**

STANDARD 4-PRONG 6V. CAR VIBRATOR. New, boxed....**$1.49**
New, slightly weathered.....**.89¢**

LOW-$$$ BATTERIES! NEW! LATE DATE!
BA-15-A. 1½ V. for test equip. Ea. **29¢**; 4 for.....**$1.00**
BA-26. 22½ V. & 45 V. Dry cells. Ea. **$1.49**; 4 for.....**5.00**
BA-38. 103½ V. for Handie-Talkie BC-611. Each **29¢**; 4 for.....**1.00**
BA-36 A & B BATTERY. For SCR-510. Has 150 V. B & 7½ V. A. Ea. **99¢**; 3 for.....**2.75**
BURGESS 2XSXX60 A & B BATTERY. 90 V. B+ & 7½ V. A. Each **$1.50**; 3 for.....**3.95**
BA-29. 4½ V. Test Set Btry. Ea. **10¢**; 12 for.....**1.00**

COMMAND EQUIPMENT! See our ad Oct./54 Radio & TV News. Loads of buys that can't be beat—anywhere!

BC-761 SIGNAL GENERATOR: 420-500 MC. 955 oscillator. New condition. Only.....**$3.49**

RA-105 POWER SUPPLY
115V, 60 cycles. Plus 2,000 V. output in several ranges. Parts alone worth $75.00. Special. Wt. 150 lbs.....**$14.95**

APN-4A LORAN: Complete with indicator, precriver, power supply, converter, plugs, racks, etc. Good condition. SPECIAL.....**$95.00**

TYPE RG8/U COAX CABLE
52 ohm. NEW. 150 ft.....**$8.49**

JENSEN J-61 PERI-DYNAMIC
8" BAFFLE. New, boxed.....**$3.49**

BC-669 TRANSMITTER-RECEIVER
50 W. Freq.: 1745-4255 Kc. All tubes and crystals. In chest. Like new condition.....**$89.50**

NOVICE CRYSTALS
Ea.....$ 1.25
10 for.....10.95
All crystals tested for activity.

AMATEUR CRYSTALS
Ea.....$ .99
10 for.....6.95
Send for FREE Crystal Catalogue!

ARB Receiver & DU-1 Loop
Freq. 195-9,950 Kc. Covers Beacon, Marine, Broadcast, 80, 75, and 40 Meters. Loop input or single wire. Motor driven band switching. Can be used to complete remote control with DU-1 amplified loop.
Excellent condition.....**$39.95**
Receiver only.....**$19.95**

2 Meter or 220 Band Variable Transmitter
Freq. 95-215 MC. 30 W. output R.F. contains 2-832, 2-5R4, 2-6C4, 1-6X5, 1-6V6, 3-6AC7, 1-931 photoelectric cell, 2-24 V. motor blowers, etc., real giveaway.
Like new.....**$17.95**

VARIAC: 5 amp. Excellent cond. Ea. **$12.50**

DYNAMOTORS
PE-103 DYNAMOTOR UNIT: With filter assembly. 6/12 VDC input. 500 VDC @ approx. 200 MA. Good, used.....**$19.50**
PE-103C: For conversion to 6 V. See May '54 C.Q. New, boxed. Only.....**$4.75**

TRANSFORMER-CHOKE SPECIAL!
CHOKE: 10 henry, 100 MA. And.....
TRANSFORMER: Pri. 117 VAC 60 cycles. Sec. 5 V. @ 3 amp.; Sec. 6.3 V. at 3 amp.; Sec. 6.3 V. at 7.5 amp. Sec. 330 VDC w/inc. 5Y3 rectifier. BOTH FOR THE PRICE OF ONE! NEW!.....**$2.95**
SWINGING CHOKE: 6-25 henry, 300 M. A. New.....**$4.95**
FILAMENT XFMR. Input 115 V. sec. 6.3 V. @ 3 amp. New.....**$2.95**

Rear Seat Speaker Kits! New! Wired!
Complete with hardware.
5"x7".....**$7.49**
6"x9".....**$8.95**

SCR-183 12 V. Receiver & Transmitter
Covers Marine, Aircraft and Ham bands with proper coil. WITH 2 coils, 2 control boxes, tuning head, flex cable, 12 V. dynamotor. Approx. 25 W. out.
Plus schematic. Only.....**$12.95**

Assorted Resistors—New!
Long pig-tails. American made—not Japanese.
Kit of 1,000.....**$7.50** | Kit of 100.....**.98¢**
Kit of 500.....**4.29** | Kit of 50.....**.65¢**

Oil-Filled Condensers — **All Brand New!**
.5 MFD @ 1,500 VDC.....**$ .79**
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2 MFD @ 4,000 VDC.....**4.95**
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New Sigma Relays
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15,000 OHM. Each.....**$2.99**
2 for only.....**5.00**
5,000 OHM. Polarized. Each.....**1.99**
3 for.....**5.00**

New 7-ft. Collapsible Antenna AN-75 with base.....**$1.29**
T-17 MIKES—good physical cond. Each.....**$2.95**

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The CK6485 is suitable for all applications where a tube must be capable of good life while operating under very small or zero cathode current. It is a heater-cathode type, high transconductance, sharp cut-off pentode of miniature construction designed for use as a wideband i.f. amplifier.

NEW SCOPE PROBES

Three new test probes designed for use with general-purpose cathode-ray oscilloscopes are now available from the Technical Sales Department of *Allen B. Du Mont Laboratories, Inc.*, Clifton, N. J.

The Types 2607 and 2608 are small, lightweight units of pistol-grip design. They are completely shielded against stray pickup and incorporate a unique tip which permits point-to-point circuit checks or which can be easily clipped to exposed circuit points for prolonged investigations.

The Type 2609 detector test probe is a small, easily-handled type that will operate over a carrier frequency range of 250 kc. to 400 mc. and has a response flat within 1 db over any 6 mc. in this range.

TUBE CHECKER

Television Engineers, Inc., 311 E. 79th Street, Chicago 19, Ill., has developed a new multi-purpose emission tube tester which is designed for the quick and accurate testing of over 300 TV and radio tubes.

Weighing only 10 pounds and measuring 15" x 12" x 6", it is built into a

sturdy brown leatherette carrying case. The "good-bad" meter and the use of only five sockets helps to speed the testing procedure. The easy-to-read visual chart lists over 300 tubes.

NEW TUBE FOR U.H.F.

The Tube Division of *Radio Corporation of America*, Harrison, N. J., has developed a sturdy, compact twin-unit beam power tube for service in fixed or mobile communications equipment operating in the u.h.f. range of 450-470 mc.

The *RCA*-6524 is engineered for use as a push-pull r.f. power amplifier or as a frequency tripler. It has a maximum plate dissipation of 25 watts under ICAS conditions and, in class C teleg-

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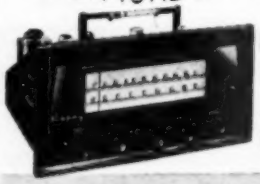

Model 710
17 TUBE
AM-FM
RECEIVER

Advanced circuit design with 2 stages of limiters driving a Foster-Seeley discriminator, drift-compensated oscillator plus automatic frequency control, maximum sensitivity obtained by tuned RF stages, built-in antennas, anti-hum control, pre-amp tube for magnetic cartridges, 23 db bass and treble controls, Williamson-type amplifier.
SENSITIVITY: 3 microvolts, AM; 5 microvolts, FM, for 30 db quieting. POWER OUTPUT: 12 watts with ½% total harmonic distortion. AUDIO RESPONSE: Flat within ½ db from 20 to 20,000 cycles. Hear quality sound reproduction in a one-chassis job.
Retail **$149.50**

Model 700 14 TUBE AM-FM TUNER
Similar characteristics to tuner portion of Model 710 Receiver. Operates with Model 501 or any standard amplifier.
Retail **$119.50**

Model 501 8 TUBE AMPLIFIER
Williamson-type 24 watt; RANGE: 20 to 20,000 cycles—distortion less than ½%. Operates with Model 700 or any standard tuner.
Retail **$79.95**

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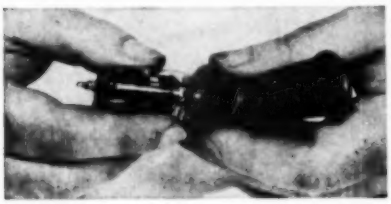
raphy and frequency-modulated service, is capable of approximately 20 watts useful power output at 462 mc. This output can be delivered with a plate voltage of only 300 volts and a plate current of 150 ma.

FOUR-WAY TUBE TOOL

General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill., has announced a new radio-TV service tool, the "4-in-1 Tube Gadget."

Made of plastic and rubber and nonbreakable, the novel device is especially



designed for service technicians. The gadget functions as a pin straightener for both 7- and 9-pin tubes as well as a tube puller and tube tapper.

"KLIPLOK" TEST CLAMPS

Trico Fuse Mfg. Co., Milwaukee 12, Wisconsin, is now offering a series of "Kliplok" test clamps for radio and TV circuit connections.

Available in a number of types, their applications include testing, grounding, clamping knife switches or fuse holders, setting up portable equipment, etc. A twist of the insulated knob applies jack screw pressure for solid mechanical grip and free flow of current.

A descriptive bulletin is available without charge from the company.

HIGH-VOLTAGE PROBE

Boland & Boyce, Inc., 236 Washington Ave., Belleville 9, N. J., is now offering a high-voltage probe which provides safe and accurate high-voltage measurements up to 30 or 60 kv. and any of a variety of other ranges with any v.t.v.m., multimeter, or voltmeter of 10,000 ohms-per-volt or more.

The new probe comes with detailed instructions and a complete set of plug-in precision resistors to match any meter rated at 10,000 ohms-per-volt or more. The probe can be used for several instruments merely by unscrewing the probe handle and inserting the proper multiplier resistor.

Further information is available on request from the manufacturer.

GARAGE DOOR OPERATOR

Alliance Manufacturing Company of Alliance, Ohio, is currently marketing a low-priced electric garage door operator which will open and close overhead type garage doors by merely pushing a button on the dashboard.

The "Lift-A-Dor" unit will also lock and unlock the door and turn the garage light on or off automatically. A radio impulse transmitter installed under the hood of any automobile is tuned to the receiver which is easily installed inside the garage.

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OR

Coyne Tested Home Training—To those who cannot come to the Coyne shops here in Chicago, we offer modern, up-to-the-minute training designed to meet Coyne standards. Practical, down-to-earth, easy to follow, step-by-step instruction. *So practical, you can quickly be earning money in* Television and Radio while learning—personal supervision by Coyne Staff—men who know TELEVISION AND RADIO, AND KNOW HOW TO TEACH IT—and the cost is low—you pay only for training—no costly extras. Send coupon below for Picture Folder and full details, including easy Payment Plan.

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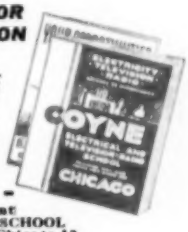

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Featuring Syncromatic Tuning

NO DRIFT UHF-VHF-DX

ONLY THE MATTISON 630 ELIMINATES DRIFTING APART OF PICTURE AND SOUND ON UHF, VHF and DX RECEPTION. SELECT YOUR CHANNEL . . . SOUND IS AUTOMATIC. (Syncromatic tuning is an exclusive Mattison 630 Circuit)

Tube Complement: 29 tubes 3 rectifiers 1 CRT

SILVER ROCKET 630 Chassis with built in UHF Tuner

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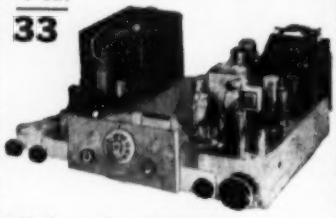

All Channel UHF Tuner

- UHF Cascode I.F. amplifier adds additional I.F. stage. Very important because UHF transmitters operate with moderate power and RECEIVER must be sensitive to give top notch UHF performance.

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Tube Complement: 28 tubes 3 rectifiers 1 CRT

Select Your Channel . . . SOUND IS AUTOMATIC!

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company's regularly established wholesale radio and TV parts distributors and dealers.

SCOPE CALIBRATOR

Service Instruments Company, 422 S. Dearborn St., Chicago, Ill., is in production on an oscilloscope calibrator which will quickly and accurately measure peak-to-peak voltages. The system employed is a comparative method where the line voltage is calibrated and compared in amplitude to the unknown waveform on the scope.

Two mounting bars are provided so that the meter can be permanently

connected to the scope and, thus, essentially adds peak-to-peak measurements to the scope. When the meter is turned off, the input is connected straight through and the unknown waveform is applied directly to the input of the oscilloscope.

MIDGET LOUVER

Midget Louver Co. of Norwalk, Conn., has introduced a new line of copper louvers which are especially suitable for ventilation and moisture vapor control for instrument and other types of electronic casings. Installed on radio transmitters, the louvers will prevent picture interference on adjacent TV receivers.

The entire line is obtainable in weather- and termite-resistant design in 1", 1½", 2", 2½", 3", 4", and 6" sizes. The company will provide full details on both its copper and aluminum models upon request.

NEW SSB FILTER

Burnell & Co., Inc., Yonkers 2, N. Y. has announced the availability of a new upper single-sideband filter, the S-16000. A companion piece to the previously announced S-15000 SSB filter, the new unit is designed for use in applications where upper sideband operation is preferred. It may be installed in any existing amateur receiver or in a new design. It can also be used for reception of regular AM signals in addition to SSB.

The new filter utilizes toroidal coils of high "Q" to provide a narrow-band, sharp cut-off response which insures maximum intelligibility and maximum signal strength. It is fixed tuned, requires no adjustment, and is compact, hermetically sealed, and trouble-free.

Additional descriptive information, including schematic and response curve, is available on request from Dept. D of the company. —30—

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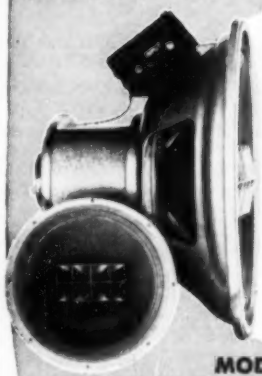

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Regarded as the international standard in high fidelity sound equipment, STEPHENS speaker systems are used throughout the world by the most discriminating listeners.

It's a SOUND PRINCIPLE when you say

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8538 Warner Drive • Culver City, Calif.

International Short-Wave

(*Continued from page 76*)

from H14T, Dominican Republic, same channel. (Sjoberg, Sweden) This one heard opening 0500, man announcer. (Headen, N. C.)

Ceylon—Radio Ceylon, 9.520, Colombo, causes QRM to Denmark, same channel, from around 2030. (Cox, Dela.) Heard 0815-0830 with popular music, excellent level in Idaho. (McDaniel) Has *English* 2030-2330 on 7.190, 11.770, and 0730-1230 on 6.006, 9.520. (Radio Sweden) VOA relay noted 1000-1030 over 11.875. (Pearce, England, others)

Chile—Radio Yungay, 7.600A, Santiago, noted from 1905 in severe QRM; CE1174, 11.742A, heard 2135 ending news in Spanish. (Hill, N. H.) Noted as early as 0625 tune-in. (Ferguson, N. C.)

China—Radio Peking, 3.960, relays Home Service 1000-1400 in Chinese, good level in N. Z. (Hardwick) Heard at poor level 2200 with news on 15.08AV. (McDaniel, Idaho) Noted opening with news on this channel 0400. (Pearce, England) The 15.385 channel has improved signal when carries news 2200. (Balbi, Calif.)

Colombia—Radio Sutatenza, HJKH, 5.070A, noted closing in Spanish 2100A. (Foster, Ill.) Is 25 kw. (*N. Z. DX Times*)

Cook Islands—Raratonga, 6.180, has a *new* session Wednesdays 2330-2400, news and music. (*N. Z. DX Times*)

Costa Rica—TIFC, 9.647, San Jose, noted 2230 at good level in *English*. (Machajewski, N. Y.; Pound, Ill.) Heard closing 2400 at strong level in N. Y. (Smith)

Cuba — COKG, 8.955A, Santiago, heard 2130-2200 with music. (McCorvey, Ga.)

Cyprus — ZJM5, 6.170, and ZJM6, 6.790, noted 2310 in Arabic, former stronger level. (Cox, Dela.) The 11.720 outlet is best in Sweden around 1000. (Radio Sweden) Heard on 9.650 at 1005 with *English* lesson for Arabs; slow-speed Arabic news 1115. (Pearce, England)

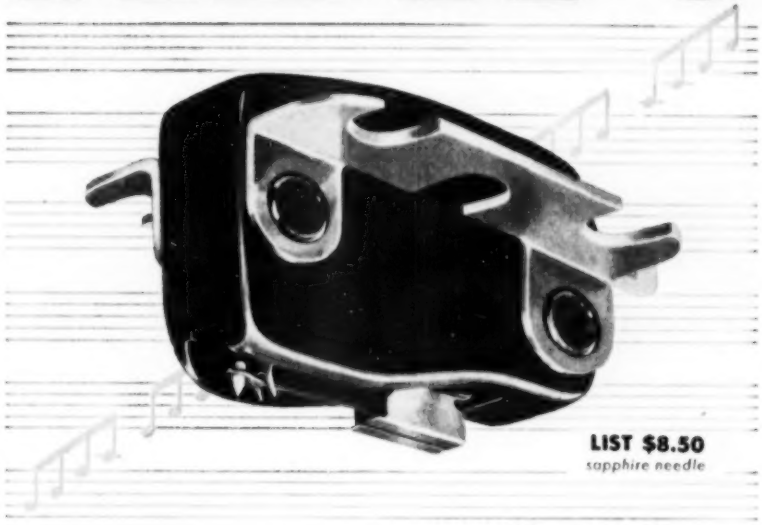
Czechoslovakia — Radio Prague, 11.760, 9.550, on Sat. at 2305 has "Answers to Listeners" session, and plays musical request numbers. (Niblack, Ind.) Lists parallel channels for North America 1930-2000 as 9.550, 11.760; at 2305-2330A as 9.550, 9.655. (Faulk, Ala.) Has *English* for Europe 0715-0745, 1400-1430 over 9.504. (Buettner, Germany)

Denmark—Copenhagen, 9.520, good level when opening to North America 2030. (Parsons, Pa., others) Closes 2030; is good in repeat session 2200-2300. (Pepper, N. C.)

Dominican Republic — HI1Z, 6.112, Ciudad Trujillo, good in Spanish around 2030. (Foster, Ill.)

Ecuador—TCJB, 11.915, noted 0700-0815 in Spanish, strong but with some CWQRM. (Todd, Ga.) This channel is good level in Oregon around 1500.

NEW!



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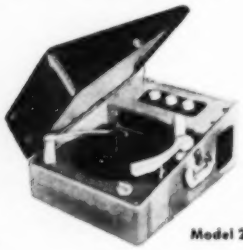
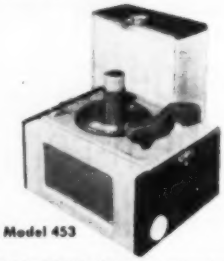


Model 2601

Model 2900



Model 453

7 PHONOGRAPHS

Model 2601 Hi-Fi Portable—A super engineered luggage type phono with console hi-fi volume.

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THE 3-IN-1 TEST TOOL

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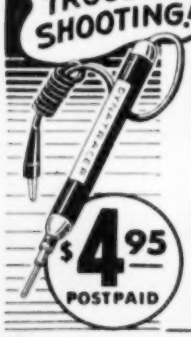

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WHAT'S MORE, this remarkable instrument traces voltages, (50/500v AC DC) and then instantly locates open, shorted, intermittent or leaky (up to 20 megohms) condensers, resistors, coils, transformers, etc.

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10,000 Servicemen Users of DYNATRACER Can't Be Wrong!

(Sicks) The 15.115 outlet is noted in Britain at 1630 in *English*. (Catch) HC2LB, 4.550, *Radio America*, is strong to closedown 0205A. (Collett, N. Z.)

El Salvador — YSUA, 6.188A, San Salvador, noted 2155 with gong and call in Spanish. (Hill, N. H.) YSS, 9.555, San Salvador, heard around 2130-2200 with musical programs. (Ferguson, N. C.)

England—BBC, 6.110, is noted 1645-1700 with music. (Lee, Tenn.) Excellent 2100 on 9.825 with news. (McCorvey, Ga.) Heard on 15.310 at 1550 with news. (Burns, Ill.)

Finland — OIX4, 15.190, Helsinki, still noted with news 0445; says repeat 0600 is for US-Canada. (Pearce, England)

France—Paris noted on 11.700 and 6.045 with *English* for British Isles 1500-1600. (Roemer, Ky.) And parallel on 9.625A. (Morgan, Calif.) Logged on 17.77 (assigned 17.76) at 1035 in French for Canada. (Parker, N. H.)

French West Africa—Radio Dakar, 9.562, noted with news in French 1510 tune-in, fair level; the 11.896A channel was good level 1500, but had heterodyne at 1700 recheck. (Cox, Dela.) Brown, England, reports Dakar on 4.950 with classical music from 1445; identifies in French 1525. (URDXC)

Germany—Cologne, 11.795, is excellent 1415 with symphonic music; news in German 1700. (Cox, Dela.) Noted on 5.980, parallel 7.290, to North America 2030-2330. (Morgan, N. Y.)

Haiti—4VEH, 9.660AV, Cap Haitien, is good level 0845 with religious program. (Cox, Dela.) Heard with Mail Bag session on a Sat. 0930A. (Foster, Ill.) *Radio Commerce*, 4VC, 9.485, is excellent Sundays when has *English* 1700-1730. (Parsons, Pa.; J. Levy, N. Y.; Kippel, Colo., others)

Holland — Radio Nederland, 11.730, Hilversum, noted at good level 1645-1725 in beam to North America-Europe; repeat to North America 2130-2210 is fair on 6.025; inaudible to poor on 6.025. (Stanley, Conn., others)

Honduras—HRP1, 6.354, San Pedro Sula, noted 2230 at good level in Spanish. (Kelley, Fla.)

Hungary — Budapest, 9.833, 11.910, 7.220, has *English* 1500-1530, 1700-1730A. (Pearce, England; Saylor, Va.) The 9.833 outlet is good level around 1945 in *English*. (Fleischman, Quebec)

India—AIR, 9.755, Delhi, is fair level 1450 with Eastern-type music; signal improves by 1515; also noted 1930 with news, weak but readable in Dela. (Cox)

Indo-China—Radio France-Asie, Saigon, 15.43A, noted with news 0400. "Voice of Vietnam," Saigon, now has news 0830 over 9.625, 6.170. (Balbi, Calif.) Latest schedule of *Radio France-Asie* shows *English* for India, Southeast Asia on 11.830 at 0900-1100 and at 2030. (Catch, England)

Israel—Brown, England, reports 4XB44, 6.690A, Tel Aviv, is heard regularly with varied musical programs to 1400 closedown with series of trumpet calls; heard from around 1245, fine level. ((URDXC) Tel Aviv, 9.008A, now has "Voice of Zion" session in French 1530-1615, and in *English* 1615-

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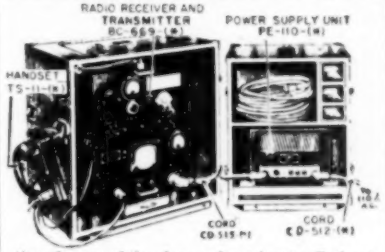
45 WATT, 6-CHANNEL RADIOTELEPHONE FOR BOAT OR FIXED STATION

This Radiotelephone Transmitter-Receiver (BC-669, part of SCR-543) is beautifully and ruggedly built. Designed for rough military service and engineered for maximum efficiency, it will provide trouble-free long-range communications from boat, vehicle, portable or fixed station installations. Both Transmitter and Receiver operate in the frequency range of 1680 to 4450 KC, and both are **crystal-controlled on all six channels** in this range. Manual tuning of the receiver is also provided. Power Output (Phone) is rated nominally at 45 watts.

Transmitter operation is performed with a minimum of controls, after installation adjustments have been made, consisting of: ON-OFF Power Switch, CHANNEL SELECTOR Switch to proper position, and ANTENNA TUNING Control rotated for maximum indication in RF Meter. This latter control may be eliminated (knob removed) without detriment by following simple instructions furnished. Also furnished are instructions and drawing for circuit modification in anticipation of new FCC regulations concerning harmonic suppression of transmitters operating in the 2 and 3 MC marine band. Operation of the 45-Watt Radiotelephone may be from 110 V. AC, 110 V. DC, 32 V. DC, 24 V. DC, or 12 V. DC. Power Supply PE-110 (shown above) (for 110 V. AC) is not available at the present time. However, complete constructional data and diagrams are furnished for building any of the above power supplies at minimum cost. For those who prefer to purchase ready manufactured power supplies, Telemarine will be glad to furnish quotations for any of the above voltage inputs. Each set is supplied with 12 crystals (6 for X-mit, 6 for receive) for operating on 1746, 2082, 2280, 2340, 3422.5 and 4255 KC. Receiving crystals differ by 385 KC (IF frequency). Most of these crystals can be reground to marine band frequencies. Receiver uses high-efficiency 10 Tube Superhet circuit with RF Stage for maximum selectivity, built-in loudspeaker. Static Filter (Noise Eliminator) Circuit with Switch, and RF Gain Control. Transmitter uses 8 Tubes (2-807's in Final) with 100% Plate Modulation, and Metering Switch with multi-range milliameter for instant checking of any part of transmitting circuit.



LOOK AT THESE FEATURES!

- COMPLETE COVERAGE 2-3 MC MARINE BAND
- 6 CRYSTAL CONTROLLED CHANNELS, X'MIT & RECEIVE
- OPTIONAL MANUAL TUNING OF RECEIVER
- FULL 10-TUBE SUPERHET RECEIVER WITH RF STAGE
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45-WATT RADIOTELEPHONE (BC-669A, B, or C Models), complete with all tubes, crystals (as specified), Inst. Book, Connecting Cord CD-515 (to Power Supply), Modification and Power Supply Constructional Data. **USED, GOOD CONDITION.** Shpg. wt. 185 lbs. **EACH** **$89.50**

SAME AS ABOVE, NEW UNUSED CONDITION **$139.50**

MODELS BC-669 D or E, Same as Above, but provides also CW (telegraphy) transmission and reception (incorp. BFO). **NEW, EACH** **$169.50**

TS-11 HANDSET, with appropriate plug connector. **EACH** **$14.50**

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This is an outstanding Direction-Finder Receiver for boat or aircraft owners, at an unusually low price for such high-quality equipment. Tunes from 15 to 70 KC, and 100 KC to 1750 KC, all in 6 bands, covering maritime radio direction-finding, aeronautical navigation and full broadcast band frequencies. You can fix position on any station operating in those frequencies, as well as on broadcast stations, and use it for broadcast band reception. 8 tube superheterodyne, receives CW and tone signals. Loop supplied with either 34" or 55" extension shaft (specify), 24 V. DC Dynamotor w/filter, instruction manual (less cables) etc., Mfd. by RCA. All NEW eqpt. Shpg. wt. 150 lbs.

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Western Electric Speaker units, for horn or baffleboard mtg. Shock and blast proof diaphragm, will handle up to 60 watts. Response to 7,000 cps, favoring high freq. Impedance 13 ohms. Dim.: 6" x 6" x 4½" deep. Throat opening — 1⅝" dia. Alnico 5 slug wt. 6 lbs.

Shpg. wt. 20 lbs.

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Real, Precision quality construction, double Helmholtz Resonator type, with combination microphone and amplifier built-in cylindrical brass case 16 x 6 ins. Uses types 30 and 32 tubes in amplifier. Employs acoustical low-pass filter plugs (removable) for 5-25 cycle response; removing plugs (threaded) and venting cylinder case will result in high-quality, wide-range studio-type microphone. As is, excellent for vibration testing, percussion noises, shock sounds, oil exploration work. Original use—Sound (Artillery) Ranging Eqpt. Model T-21/6R-3-C. NEW UNITS. Shpg. wt. 20 lbs.

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FRONT-END LENS, for Infra-Red Tube. Bausch & Lomb. . Ea. **$10.00**
Plain, Mounted Type. . . . . Ea. **7.00**

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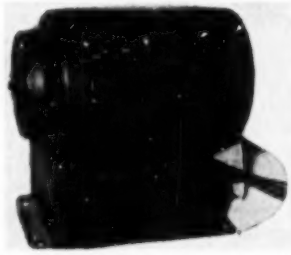
32 VDC-110V AC CONVERTER



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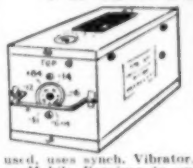
Phone: ES 2-4300

6 or 12 V. DC VIBRATOR POWER SUPPLY



This is the popular PE-104 Vibrator Power Pack, used with the SCR-284 Field Eqpt. Operates from either 6 or 12 V. DC input and delivers following completely filtered voltages: 1½, —45 (Bias) and 90 Volts DC. No tubes used, uses synch. Vibrator. Ideal for Transceivers, or Mobile Receiver to operate in any car (6 or 12 V. Supply). Fully shielded. Dim. 3" x 4⅝" x 6⅛". Shpg. Wt. 12 lbs. Complete with vibrator, NEW UNITS. **EACH** **$14.95**

SPARE VIBRATOR. Special Synch. Vibrator; better have a spare while available. **EACH** **$3.75**

POGO STICK WALKY-TALKY

Sensational Hi-Efficiency Walky-Talky, known as BC-745 (Transmitter-Receiver) part of SCR-511, used widely by CAP. Excellent for emergency communications, scouting, liaison, patrol contact, etc. Freq. range 3.0 to 6.0 mc. Power Output 0.75 Watt. Crystal control of both transmitter and receiver. Plug-in Tuning Units (BC-746) with crystals employed for frequency changing. Uses 6 miniature tubes in modern superhet receiving circuit, and 4 miniature 384 Power tubes in transmitter. Modulation is 100% Plate type. Telescopic rod antenna turns power "on" or "off" when extended or collapsed.

The BC-745 Transmitter-Receiver may be used with Chest Unit T-39, which houses the necessary dry batteries (BA-49, consisting of a 1½ V. "A" battery and two 67.5 V. "B" batteries) and speaker microphone unit. Or, it may be used with the PE-157 Power Supply, which supplies all necessary A & B voltages from an internal 2 volt storage battery. This power supply has a built-in loudspeaker, but provides for separate headphones and microphone.

PRICE, EACH BC-745 POGO-STICK TRANS-RECEIVER, with tubes, connecting cord CD-571, and 1 BC-746 Tuning Unit. USED, GOOD CONDITION. Shpg. Wt. 15 lbs. **EACH** **$39.50**

SAME AS ABOVE, NEW CONDITION — EACH $59.50

CHEST-UNIT T-39, Excellent Condition, Shpg. Wt. 5 lbs. **EACH** **$15.00**

POWER SUPPLY PE-157, with Internal 2 Volt Storage Battery, Excellent Condition, Shpg. Wt. 15 lbs. **EACH** **$24.50**

ADDITIONAL BC-746 TUNING UNITS, with crystals. Specify preferred frequencies, NEW. **EACH** **$2.95**

SPARE TRANS-RECEIVER CHASSIS, NEW, less tubes. Shpg. Wt. 8 lbs., **EACH** **$12.95**

MISCELLANEOUS BARGAINS

GO-9 TRANSMITTERS, 100/125 W. output, 300 to 600 KC and 3,000 to 18,100 KC, with rectifier power supply for 110 V. 600-800 cycles AC. NEW condition, export packed, less Tubes. **EACH** **$99.50**

ATC PHONE TRANSMITTER, 50 W. output A1 & A3, 1.5 to 9.05 mc, 4-channels (VFO) complete with 24/28 V. DC Dynamotor and other accessories. **EACH** **$99.50**

BC-684 FM TRANSMITTER, 25 W. output, 27.0 to 38.9 mc, 10 x'tal controlled channels. With tubes and DM-35 (12 V.) Dynamotor. Excellent Condition. **EACH** **$49.50**

BC-604 FM TRANSMITTER. Same as above, but 20.0 to 27.9 mc. Excellent Condition. **EACH** **$49.50**

SCR-522 VHF TRANSMITTER-RECEIVER, 100-156 mc, 4 crystal channels. Consists of BC-625 Transmitter, BC-624 Receiver, in Case CS-80. No accessories. Excellent Condition, with tubes. **EACH** **$72.50**

BC-659 FM TRANS-RECEIVER, 2-channel crystal-controlled vehicular communication eqpt., operating between 27.0 and 38.9 mc. With tubes, excellent condition. **EACH** **$69.50**

BC-620 FM TRANS-RECEIVER. Same as above but freq. range 20.0 to 27.9 mc. **EACH** **$64.50**

PE-117 or 120 POWER SUPPLY, Power Supply for BC-620 or BC-659, to operate from vehicular battery. Excellent Condition. **EACH** **$29.50**

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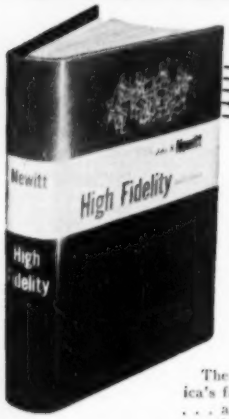

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by John H. Newitt

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1700 (Sat. to 1720A). (J. Levy, N. Y., others) Has moderate CWQRM. (Churchill, Va.) Is nice level in N. C. (Headen)

Italy—Rome, 11.905, 9.575, are both good when opening 1915A to North America in English. (Jacobson, Ill.; Headen, N. C., others)

Jamaica—Radio Jamaica, 3.360, noted 2150 with QRM from YVOC, Venezuela. (Cox, Dela.)

Japan—At press time, current revised schedule for *Radio Japan* was 0000-0100, 9.695, 11.780; 0200-0300, 9.695, 11.780; 1800-1900, 15.135, 11.780; 0400-0500, 9.695, 11.780; 0530-0730, 9.695, 7.180; 0900-1000, 9.695, 11.725; 0745-0845, 9.695, 11.725; 1000-1100, 9.695, 11.725; 1115-1215, 9.695, 11.725; 1230-1330, 9.695, 7.180; 1400-1500, 9.695, 7.180. Has Mail Bag session now the second and fourth Mondays in Australia-New Zealand beam 0430 (on 9.695, 11.780). (Gay, Calif.; Cushen, N. Z., others) *Far East Network,* AFRS, Tokyo, noted with news to 0815 on 6.16A, very good level in Idaho. (McDaniel) Is now on *announced* 11.750 instead of 11.760 as formerly; audible as early as 2300 signs off 0515, fair to good level. JKI, 4.91, replaced JK12, 9.655, heard from 0300; JBD, 9.505, and JBD2, 9.560, heard irregularly *after* 0500 in Home Service. (Balbi, Calif.)

By this time the last hour's broadcast by the Tokyo commercial outlets, JOZ, 3.925, JOZ2, 6.050, should be in *English;* closedown is normally 1000; heard in N. Z. from 0600. (*N. Z. DX Times*)

Kenya Colony—Nairobi, 4.885, noted closing 1501 with "God Save the Queen." (Pearce, England) Sunday closedown is 1400; has BBC news relay 1300. (ISWC, London) Noted parallel on 3.320A, weak level 1300-1500. (Hardwick, N. Z.)

Lebanon—Beirut, 8.036, is heard at good strength in France 1300-1415, but often has much QRM, *less interference noted Sundays;* news in French 1300. (La Radio Mondiale, France)

Leeward Islands—Radio Montserrat, 3.255, 50 watts, operates 1130-1200 Sundays (religious programs) and 1500-1530 Sundays (news-music); 1300-1330 Wednesdays (programs for local schools); station is designed "to keep the scattered population of the island in touch with island matters," say officials of the station. (Scheiner, N. J.)

Luxembourg — Radio Luxembourg, 6.090, noted closing 1758 in French. (Ferguson, N. C.)

Madagascar — Radio Tananarive, 9.515, noted opening 2230 in French, good level in Ohio. (Riggle)

Malaya — BFEBS, 9.690, Singapore, noted 1000 with popular music. (McDaniel, Idaho) Heard on 11.820 with BBC news relay 0800. (Sutton, Ohio) Noted on 15.300 recently with "London Calling Asia" relay from BBC at 0815. (Fledelius, Denmark)

Mexico—XEHH, 11.880, very strong 1530 in Spanish. (Grenell, Ohio) XEFC, 15.205, "La Mas Espanola," noted 1830 in Spanish, fair level in Alta. (Deuring) *Radio Mil,* 6.010, usually is good signal

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This work is on an extremely interesting application of automatic control to the unique characteristics of the HELICOPTER.

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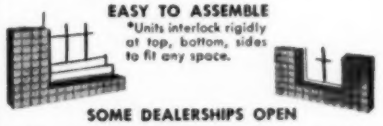

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THE CINCINNATI VENTILATING CO. INC.
THIRD & MADISON STS., COVINGTON, KY.

strength from around 2200 to 0200A closedown. (Butcher, Mass.)

Mozambique — CR7AB, 3.490, Lourenco Marques, noted in *English* with popular music 1245, fair level in N. Z. (Hardwick) CR7BU is noted close 4.928 now in *English* from 2300 with popular request numbers. (Cox, Dela.)

New Caledonia — Radio Noumea, 3.375A, noted 0530 with French news, music. (Sanderson, Australia) Heard opening 1400 with popular recordings, fair to good level in N. Z. (Collett) Noted on 6.035 at 0257 with music, fair level in N. Y. (Morgan)

New Zealand — ZL19, 11.830, good level with popular music, 2245; 11.780 channel in parallel is also fair to good then. (Cox, Dela.) ZL2, 9.540 is excellet to 0545A closedown. (Adam, Brt. Columbia)

Nigeria—Lagos, 4.800, noted 1640 in *English;* closed 1700A with "God Save the Queen." (Pearce, England) Lagos, 6.100, heard 1400 in *English;* on 7.185 at 1330 in *English.* (Hardwick, N. Z.) The regional outlet at Kaduna, 3.326, is heard 1400-1500. (Collett, N. Z.)

Northern Rhodesia — Lusaka, 3.346, relays BBC news 1300; fair with some CWQRM. (Hardwick, N. Z.)

Norway—Oslo, 9.610, is good level to North America daily 2000-2100. (Salovey, N. Y.)

Pakistan — Radio Pakistan noted opening 15.360A at 0745 for Indonesia, news 0800; heard on 9.484 with news 0945-1000 now; in *English* 0445 on 15.255. (Pearce, England) Karachi, 17.750, has news 0700-0710. (Buettner, Germany) Heard with news on 11.885 at 2000. (Sanderson, Australia)

Panama — Radio Provincias, 9.647, noted 1845 with popular music, with QRM to and from TIFC, Costa Rica, same channel. (Cox, Dela.)

Paraguay—ZPA5, 11.950, *Radio Encarnacion,* noted in Spanish 1530, fair signal. (Hardwick, N. Z.) ZPA3, *Radio Teleco,* 11.850, noted to fade-out around 1645. (Sjoberg, Sweden)

Peru—OAX4V, 4.991, *Radio America,* heard in Spanish 2230, good level; OAX4H, 6.307, *Radio Mundial,* noted in Spanish 2200, good. (Hardwick, N. Z.) OAX4W, 9.404, Lima, strong around 2300. (Cox, Dela.) *Radio Tacna,* 9.490A, noted at fair strength 2115-2145 with music and commercials in Spanish, mostly by woman. (Hill, N. H.) *English* from OAX4Z, 6.082, Lima, is 2300-2315 on Mon.-Fri. (Roemer, Ky.; Gay, Calif.; Kippel, Colo.)

Philippines — DZH9, 11.855, DZH7, 9.730, Manila, noted 1100 with religious program, fair level but with heavy QRN. (McDaniel, Idaho) DZH4, 6.000, noted at good level 0900-1000; DYH2, 6.140, heard closing 1000 at poor level. (Christie, Calif.) DZH2, 9.640, noted 0445 with music, then with news 0500. (Sanderson, Australia)

Poland — Radio Warsaw, 9.568A, noted ending *English* to North America 2355A. (Bulmur, Manitoba) Heard with *English* on 6.195 at 1730-1800. (Pearce, England)

Portugal—Lisbon noted on *measured* 9.220 at 1615 in Portuguese, still going

New SURPLUS AT NEW LOW PRICES

RADIO STANDARD SURPLUS ELECTRONICS

12 VOLT DYNAMOTOR
PE-55 Power Pack. Complete New Unit with DM-19 Dynamotor, Filter and Relay Base. Continuous Ratings, 500 V. @ 200 MA output or Intermittent 500 V. @ 400 MA. These are all NEW in original cases ..... $17.95 Ea.
Output Cable for above dynamotor ..... $2.95 Ea.

RM-29 FIELD PHONES
Remote control unit for Transmitter or Receiver which can be used in pairs over wire with internal 4½ V. battery as field telephones. Enclosed in a metal case and with a canvas carrying bag. Ideal for House to Garage or Intercom. All NEW less handsets @ $8.95 Ea. ..... $16.95/Pr. Ea.

PE 104 VIBRATOR POWER SUPPLY
Part of BC-654 Transformer, Input, 60 ~ 12V.D.C. Output, 6, 14 and 84 U.D.C. Pos. 1.4, 0, 12 and 51 V.D.C. Neg.
In excellent condition ..... $8.95 Ea.

SIGNAL LIGHTS
Type K3, 12 Volt Signal Lamps. Portable bakelite enclosed 12 Volt Sealed Beam Light. Use as Flashing Signal or Steady Spot. Comes with mounting bracket for permanent mount with carrying case, and 20 feet rubber covered Heavy Duty Extension Cord. All New ..... $4.95 Ea.

12 or 24 VOLT VIBRATOR INVERTER
Use for Mobile Radio, Trucks, Boats, etc., where 110 Volt, 60 Cycle is desired. Can be used on 12 Volts or 24 Volts D.C. input. 110 V., 60 cycle, 240 watt maximum output. Uses separate vibrator for each input voltage. In enclosed case, excellent condition $27.50

12 Volt 68 Amp. Hour Battery—New $14.95

PARTS BOXES
Durable, Strong Wood Boxes with 2 drawers. Corners are iron bound. Will make an ideal box for storing small resistors, condensers, fuses, or any small parts or tools. Box dimensions 10½" W. x 17½" L. x 7" H. Drawer dimensions are 9½" W. x 16¼" L. x 2¾" H. Hinged cover and carrying handle. All New ..... $2.95 Ea.

LOW VOLTAGE CIRCUIT TESTERS
These Testers made for checking complete ignition system 6 or 12 Volt cars or trucks. Generator, Regulator, Battery, Etc. Can be checked individually or together while engine is running or still. These units are all in excellent condition. Low Priced ..... $17.95 Ea.

SOUND POWER HANDSETS
Use these phones without any external or internal voltage supply. Two or more can be used with only 2 wires interconnecting them. Use for TV installation, house to house or house to garage.
All new ..... Per Pair $18.95

FIELD TELEPHONES
EE-8 Type. Uses 2 1½ V. Flashlight Batteries for Power. Transmits over wire up to 50 Ω miles with Magneto Ringer. In Leather Case. In excellent Condition ..... $32.50 Per Pair

HEAD SETS
High Impedance R-14 Phones 8000 Ohm. For all standard Radio Output Circuits.
All New ..... $2.50 Ea.

ARMY AMMUNITION CANS
Type M-3 50 Cal. Cans 12" Long x 6" Wide x 7½" Deep.
Type M-1 Cans 16½" Long x 3½" Wide x 6½" Deep.
All aluminum with Leather Handle and Hinged Top with hasp. Use for all your small parts or tools. O.D. Color, clean them and buff or paint ..... Each $1.50

RADIO DIRECTION FINDER
BC-1003 Receiver. Frequency Range 100 KC-1000 KC in 3 bands. Has Loops mounted on top with Sense and Balance Circuits, Less power supply. In Exc. Cond. with Tubes ..... $49.95 Ea.
12 V. Input Dyn. for above Receiver $9.95 Ea.

SPECIAL A.C. MOTORS
1/40 Horse Power Bodine Sync. Motor, 1800 R.P.M. KCF-1000 KC in 3 bands. Has Loops mounted on top with Sense and Balance Circuits, Less power supply. In Exc. Cond. with Tubes ..... $49.95 Ea.
12 V. Input Dyn. for above Receiver $9.95 Ea.

SPECIAL A.C. MOTORS
1/40 Horse Power Bodine Sync. Motor, 1800 R.P.M. Made on 110 V. 60 Cy. Has 2 shafts and type flange mount. Uses 5 Mfd. capacitor for starting. Used for Fan, or small Grinder, Buffer or Hobby work. All in excellent condition.
Price ..... Ea. $7.95
Capacitor ..... Ea. $1.00

MIDGET SELSYNS
AY6 type operates from 6-12 Volts 60 Cycle. Use as both transmitter and receiver. These compact little units draw almost no current and work fine for all remote position indicating applications. OD 2½x2¼x2". Has sprint return shaft. All New (Appr. wt. 1 lb.) ..... Each $1.95

SELSYN MOTORS
Type 5F Synchro Motors, used in pairs for remote tuning or remote position indicators. 115 V., 60 Cy. operation. Size 3¼" Diam. x 5¼" long. Like New ..... $35.00 Pair

BC 375 TUNING UNITS
TU-3 (200-500 KC), TU-(10,000-12,500 KC), TU-8 (6200-7700 KC), TU-9 (7700-10000 KC), All with Vernier Dials, and Many useful parts. All used ..... Low Price @ $1.50 Ea.

POLE CLIMBERS AND BELTS
Telephone Type Climbers with Leather Leg Straps. Used, Excellent Cond. ..... Pair $2.95 Ea.
Safety Tool Belts, Leather, to use with pole climbers. Used, Excellent Cond. ..... $3.50 Ea.

METERS
3" G.E., Westinghouse, Panel Mount
0-7.5 AC V. 0-100 MA. DC 0-250 MA. DC
0-15 AC V. 0-200 MA. DC 0-500 MA. DC
Your Choice ..... $4.50 Ea., 3 for $12.00

"FRAHM" Vibrating Reed Frequency Meter 57.5-62.5 Cycles, 115 V. ALL NEW ..... $14.95 Ea.

FLUORESCENT FLOODLIGHT
This unit uses 6 15 Watt fluorescent bulbs in parallel on 115 V., 60 CY. AC. Unit measures 21" x 21" x 4" and weighs approx. 30 lbs. Will make an ideal Ranch Light, Garage Light, etc. 2 or more for photographic or Floodlights. These units are all NEW. This is a $75.00 Value, priced specially low less tubes with starters and ballasts. $14.95 Ea.

RADIOSONDE UNITS
Type AN/AMQ-1. Used by weather stations. Unit is sent into air on balloon to transmit information on temperature, moisture, and barometric pressure to the ground. All New ..... $4.94 Ea.

TUBE SPECIALS
2K54 ..... $24.95 Ea.
5J23 ..... 9.95 Ea.
All New—Original Carton.

Thousands! CRYSTALS Thousands!
FT-241 54th Harmonic Type. Fundamental Frequencies listed below in KC.

370	390	410	430	449	469	486	508	
372	392	412	432	451	470	488	510	
374	394	414	434	453	471	490	512	
376	396	416	436	454	473	492	514	
378	398	418	438	456	475	494	516	
380	399	420	440	458	477	498	518	
382	400	422	442	460	479	498	520	
384	402	424	444	462	480	502		
386	404	426	449	464	482	504		
388	406	428	447	466	484	506		

Each Frequency ..... 6 For $1.00
500 KC 1.25

CRYSTALS DC-34 and DC-35, ¾" Spacing

1690	2090	2360	2710	3000	3390	3708	3890	4065	4280
1705	2105	2375	2711	3010	3395	3702.5	3895	4080	4305
1720	2106	2390	2732	3027.5	3412	3705	3905	4085	4310
1770	2155	2395	2745	3077.5	3440	3710	3920	4090	4325
1790	2175	2415	2764	3095	3462.5	3730	3925	4095	4335
1810	2195	2422	2775	3117	2480	3745	3935	4115	4345
1830	2202	2435	2776	3149	3485	3750	3940	4130	4350
1850	2215	2446	2807	3155	3500	3765	3950	4135	4370
1870	2220	2466	2816	3161	3520	3770	3960	4150	4380
1890	2235	2478	2831	3190	3540	3775	3965	4155	4397.5
1910	2240	2491	2851	3201	3550	3790	3985	4175	4405
1930	2255	2514	2863	3270	3575	3792.5	3990	4177.5	4115
1950	2258	2540	2894	3279	3580	3807.5	4012.5	4192.5	4435
1970	2275	2586	2899	3280	3610	3825	4015	4210	4440
1990	2300	2587	2925	3311	3630	3830	4020	4215	
2010	2315	2605	2926	3317.5	3650	3850	4030	4235	
2030	2326	2625	2960	3345	3655	3855	4035	4240	
2050	2335	2643	2971	3365	3665	3870	4050	4255	
2075	2355	2685	2980	3385	3680	3885	4055	4275	

PRICE 85c Ea. ..... 6 for $4.50
SHIP BAND FREQUENCIES 2143, 2174, 2638, 2670 ..... $2.00 Ea.

MICA CAPACITORS
FIG. A UPRIGHT MOUNTINGS

MFD.	Ea.	MFD.	Ea.	MFD.	Ea.
1000 V.		2500 V.		00006	.25
.1	$1.00	.025	2.25	00005	.95
.07	.95	.00075	1.50	5000 V.	
.083	.90	.0006	1.50	.004	2.50
.09	.85	.00025	1.39	.002	2.25
1500 V.		3000 V.		.0015	2.25
.075	1.25	.006	1.50	.001	2.25
.08	1.10	.005	1.50	.0009	2.25
.039	1.10	.004	1.50	.00075	2.25
.03	1.00	.003	1.50	.0005	2.75
2000 V.		.002	1.50	.00045	2.25
.03	2.25	3000 V.		.0004	2.25
.01	2.00	.000625	1.39	.0002	1.75
.006	1.50	.00055	1.25	.00009	1.50
.005	1.50	.0004	1.25	7500 V.	
.003	1.25	.00025	1.25	.0005	3.95
.00275	1.25	.0002	1.15	8000 V.	
.0025	1.25	.00009	1.10	.01	5.95
.00125	1.00	.00006	1.00	.0006	4.50
.00063	1.00	.000075	1.00	.0005	4.50
				.00025	3.95

FIG. B SCREW TERMINAL

800 V.		1200 V.		2500 V.	
.05	1.00	.022	.85	.015	1.50
.04	.85	.02	.85	.01	1.50
.02	.75	.01	.75	.0033	1.25
600 V.		.001	.65	.003	1.25
.01	.65	.005	.50	.002	1.00
.047	.85	1250 V.		.0015	1.00
.03	.75	.03	.95	.00063	.90
.0378	.75	.025	.85	.0006	.90
.02	.75	.01	.80	.0005	.90
.0005	.45	.006	.60	.0004	.85
.00015	.35	.004	.50	.00025	.85
.00005	.35	2000 V.		.00015	.85
1000 V.		.01	.75	.00005	.75
.01	.75	.0004	.75	3000 V.	
.00005	.90	.00007	.75	.005	1.90

CAPACITORS ● FIXED ● OIL FILLED
Solar, Pyranol, C.D., Etc.
ALL D.C. VOLTAGE RATINGS

2	MFD.	400 V	$0.70	1 MFD. 1000 V	$1.00
3X3	MFD.	400 V	1.95	2 MFD. 1000 V	1.25
10	MFD.	400 V	2.95	8 MFD. 1000 V	3.95
1	MFD.	600 V	.75	10 MFD. 1000 V	4.95
4	MFD.	600 V	1.95	1 MFD. 1500 V	1.50
6	MFD.	600 V	1.95	1 MFD. 1500 V	1.95
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at 1830 recheck. (Ferguson, N. C.) Heard on 11.996 at fair level in Portuguese to Africa 1500-1530. (Deuring, Alta.) Heard on 11.835A parallel 11.910A at 1630 (on a Sun.). (Niblack, Ind.) Heard closing on 9.360A at 1545, reopened there 1600. (Scheiner, N. J.) Is fine level to North America 2000-2100 on 9.746A. (Jacobson, Ill.)

Roumania—Bucharest, 9.524A, noted 1400 with news in French, in clear. (de Mesquita e Sousa, Portugal) Heard on 9.570 with *English* to North America 2200-2230, 2330-2400; strong level but with heterodyne in Colo. (Kippel)

Seychelles—ZCQ3, Mahe, 5.770A, is scheduled 1015-1115 weekdays, 0900-1000 Sun. Uses *English* and French. (*WRH*)

South Africa—Johannesburg, 4.895, is coming through weak to fair from 2345 opening with setting-up exercises in Afrikaans. (Cox, Dela.) Has news in that language 0000. (Saylor, Va.)

South Korea—American Forces Korean Network, 6.895, is audible after 0700 to around 0830; has AFRS news 0700. (Christie, Calif.) Seoul, 7.935, heard 0430 with Western music and news in Korean. (Sanderson, Australia)

Surinam—PZH5, 5.762, Paramaribo, noted in terrific QRM 2030 with announcements in Dutch; closed 2035 with Anthem. (Hill, N. H.) Heard in Sweden on 15.405A at 1720-1740, bad QSB. (Sjoberg)

Sweden—Stockholm, 9.620, noted in English 2100 (Roberts, Conn.)

Syria—Damascus, 9.555, is fair level in French 1530-1630, in *English* 1630-1730 closedown. (Cox, Dela.; Pearce, England, others)

Tahiti—Radio Tahiti, Papeete, has poor signals on 7.120A but the 7.025 outlet is sometimes fairly good around 0100-0200. (Gay, Calif.) The 7.025 outlet is good in French 0000. (Hardwick, N. Z.)

Taiwan (Formosa)—BED6, 11.735A, Taipeh, is now noted *after* 0730 at fair level in N. H. (Hill) BEC22, 7.000, Taipeh, has Western music 0400, but usually with bad CWQRM. (Radio Australia)

Tangier—VOA's relay of *Radio Maroc*, Rabat, Fr. Morocco, on 15.205 is noted 0730-0930 at good level in Portugal. (de Mesquita e Sousa)

Uruguay—Radio Carve, CXA13, 6.155, is very strong from 1900; CXA19, 11.835, is good level 1600. (Collett, N. Z.)

USI (Indonesia)—YDF8, 9.865, Djakarta, is only partly readable 1400-1500 during *English* period to Europe; news 1430A, then dance music; much QRN. (Cox, Dela.) Heard on 9.710 in *English* 0600-0700, weak to fair level in Ill. (Jacobson)

Vatican—HVJ, 9.646A, noted 1315 with *English;* closed 1330 but reopened in French 1345. (Hill, N. H.) Heard parallel over 11.685, 15.120. (Kelley, Fla.)

Windward Islands—There is no local broadcasting organization but the Government of St. Vincent has arranged a weekly broadcast over an

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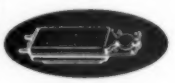

Model W78 is a Dual-Volt, Dual-Weight Cartridge—so versatile it replaces 149 other cartridges! This cartridge alone will become a sensation overnight—because it replaces steel or aluminum case cartridges, of either high or low output! The W78 provides the broadest coverage at the lowest investment—only $5.55 list.

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amateur station—*not* in the amateur bands. *(WRH) Further details are desired.*

Yugoslavia—Belgrade has *English* now 1715-1730 on 6.100; at 1330-1345 on 6.100, 7.200. (Pearce, England)

* * *

Press Time Flashes

The "Voice of the United Nations Command" station on 4.780 at 1400 and 1430 identifies as "VUNC," being the initial letters of words which make up the slogan. (Cushen, N. Z.) Location is believed Japan.

British Forces Station, 6.100A, Kure, Japan, is noted with religious service 0330, BBC news relay 0400; fair level with QRM from Radio Peking. A station announcing as "Voice of Vietnam," evidently located in Indo-China, is noted on 11.91 at 0500 with native program, 0530 with announcement in French and then news in that language. *Radio Sarawak*, 4.870, Brt. Borneo, now has BBC news relay 0800 and closes 0830A. (Balbi, Morgan, Calif.)

Sociedad Nacional de Mineria, Santiago, Chile, noted recently on *measured* 12.382 (varying to 12.388) around 1925. (Ferguson, N. C.) Is CE1198. (Saylor, Va.)

Radio Corporation of Puerto Rico heard *testing* 0830-0840 on 9.100A. (Beres, N. J.) Noted *testing* on 15.410A. (Southwestern Short Wave Club, Texas) Clandestine *Radio Stanica Yugoslavia*, 6.895A, noted from 1700 to 1843 closedown with talks by man, frequent identification by woman. (Butcher, Mass.) A new 10 kw. shortwave transmitter is to open officially soon at Karachi, Pakistan. (Scheiner, N. J.) *Radio Omdurman*, Anglo-Egyptian Sudan, has *English* daily 0215-0230, Sundays to 0245; also 1000-1015 over 4.995, 7.100, and 6.410. (ISWC, London) Buettner, Germany, confirms that Saarbruecken plans to install a short-wave service. *Radio Sweden* now uses 9.535 to Western North America 0000-0045, 1100-1145.

A *new* Taipeh, Taiwan (Formosa) outlet is noted on 9.945 in parallel with BEC22, 7.000, around 0445; at 0515 has lesson in *English;* BED38, 5.960, heard 0500 with separate program. (Balbi, Calif.)

Radio Peking, China, has added many *new* frequencies of late—including 15.253, 3.960, 3.915A; Shanghai is now using 9.730; Chungking still uses 11.000V at 1700-1840, 2300-0020, 0430-1015. Home Services are now on 11.930, 9.730, 3.960. A *new* channel of 11.895 is heard 1700-1840, 2030-0015. Mukden (Manchuria) has *moved* from 3.660 to 6.520V; Sian has *moved* from 6.495 to 6.369. The Home Service *moved* from 10.203V to 11.830 where it was heard at poor strength. Peking has been heard 0655-0700 with Home Service on 3.917A (fair), 3.960A (poor), 6.103 (good), 6.201 (excellent), 6.225 (good), 6.748V (excellent), 7.500 (good), 9.040 (fair), 9.080 (fair). A Chinese outlet on 6.953A heard 0856 with woman in Chinese dialect, severe QRM, may be Kumming. Taipeh,

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7.130, Taiwan (Formosa), apparently now runs to 0830V closedown; opens again 1000 with another Chinese dialect program and runs to 1030 or 1045. "Voice of Vietnam," Indo-China, heard on *new* channel of 7.260 with French news 0947; *Radio Laos*, 7.216, heard closing at fair level with calls by woman in French, then "La Marseillaise." YDQ2, 9.550, Makassar, Celebes, USI (Indonesia), has improved signal, heard 0952 with music, then closing with piece on Hawaiian guitar 0957. Naha, Okinawa, VOA relay, noted on *new* 9.630 at 1003 with Asian program. (Morgan, Calif.)

Provided support from hams and SWL's is great enough, there will be transmitters continuously in operation on the 7, 14, and 21 mc. bands, Christmas Day, during an eclipse in South Africa. Call will be ZS2RU. The purpose is to determine the effects of the eclipse on radio propagation. Those desiring further information should address their requests to A. P. Dale, Rhodes University, Grahamstown, C.P., South Africa (Grenell, Ohio).

* * *

Acknowledgement

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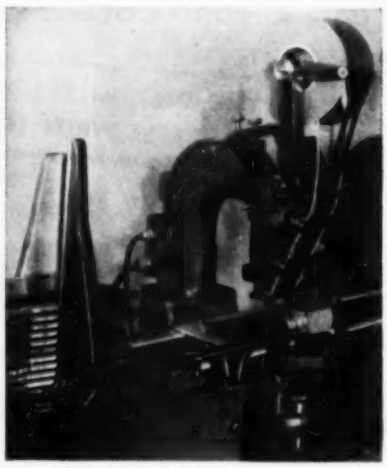

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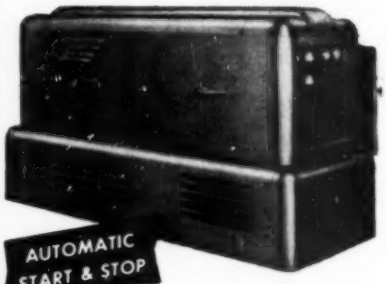

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THE INVERTED GROUND PLANE

By **JOSEPH W. SEMKOW, W7IIP**

Don't overlook such "tried and true" antennas as the 75-meter dipole when you are seeking a good, all-band signal "catcher".

AS HAMS we are all naturally interested in new antennas or performance details on the "tried and true" ones. The antenna to be discussed is the old standby, the 75-meter dipole fed with a conventional transmission line.

The author has used this antenna for over 20 years both in the conventional manner and in the manner about to be described. To illustrate the operation of this antenna on all bands, refer to the diagrams of Fig. 1. Fig. 1A is the antenna in its conventional form. Certain requirements must be met for this antenna to perform well. First, the direction in which it runs (the direction of the flat-top portion) is important. Next, it must be at least 50 feet above ground and preferably horizontal. Finally, the two-wire transmission line must hang down perpendicularly for at least 50 feet and should not be over 60 feet in length. The horizontal flat-top must be approximately 60 feet long on each side of the transmission line or an over-all length of 120 feet.

It is desirable, although not necessary, to use an antenna coupler at the transmitter end. See Fig. 1A for the current flow when used in this manner. Fig. 1B shows the current flow when used as an inverted ground plane on 80 meters, while Fig. 1C indicates the current flow when the antenna is excited on 40 meters in the conventional manner. Fig. 1D is the result when the antenna operates as a vertical on 40 meters.

Now to the "meat" and meaning of the "inverted ground plane." First let's consider operation on the 75- or 80-meter amateur band. If the antenna is to be used for North-South transmission path, then it can be worked two ways. In all discussions of direction, the horizontal flat-top axis is East-West. To work North and South it is best, under most conditions, to operate in the conventional manner as a half-wave dipole fed with a resonant transmission line. It will then be directional North and South. Normally, during the daylight hours, it will show very little directive power because all transmission paths *via* the Heaviside layer are at very high angles. At night and at ranges in excess of 1500 miles, it will be directive North and South with poor performance off the ends. This is due to the low-angle radiation paths at night and very little radiation from the ends or axis of the horizontal flat-top portion.

Now to the "unconventional" aspects of operating the "inverted ground plane." By means of a small change at the antenna coupler end of the transmission line it is possible to create a very efficient low-angle radiator, not only in the East and West path but in the North and South path as well. When the antenna is used as a conventional dipole, the transmission line currents are equal and 180 degrees out-of-phase. Negligible transmission line radiation occurs. The currents are equal and opposite. The radiation of the flat-top is mainly North and South. See Fig. 1A. If we now disconnect the transmission line and tie the line together at the antenna coupler and tune it against ground, the following conditions obtain. The transmission line currents are now in-phase. The line is approximately a quarter wave long and as it is attached at the center, or balance point, of the horizontal portion all radiation is *via* the transmission line. The currents in the horizontal portion are out-of-phase. See Fig. 1B.

The horizontal flat-top portions are approximately a quarter wave long and their extremities will have voltage loops. The current loop will occur at the junction of the transmission line (now radiator) and the flat-top portion. The vertical transmission line (radiator) will likewise have its current loop at the top, and a quarter wave away, at the antenna coupler, will be the voltage loop. The system is voltage-fed, resulting in the "inverted ground plane."

The current loops occur high in the air (at least 50 feet above ground) and

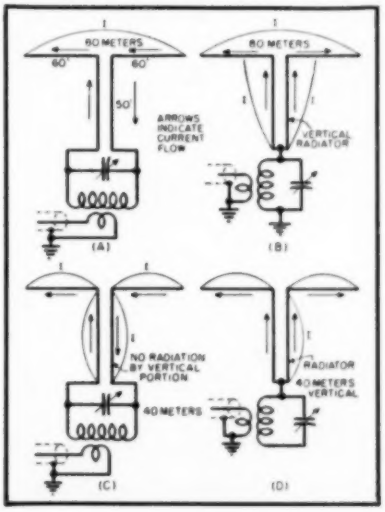

Fig. 1. The four modes of operating a 75-meter dipole fed with a conventional transmission line. (A) Standard method. (B) As an "inverted ground plane" on 80 meters. (C) Standard method on 40 meters, and (D) as a vertical on 40 meters. Details in text.

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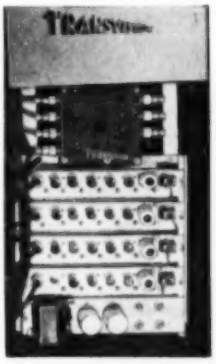

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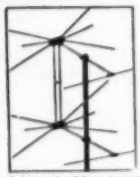

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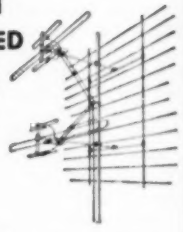

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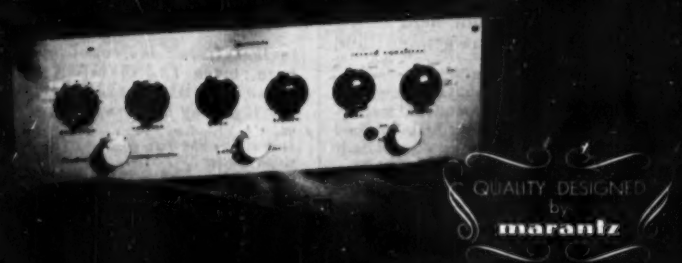

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operation may be equal or superior to conventional ground planes. Their current loops occur at the ground level or base of the antenna. Conventional verticals demand good ground systems but the "inverted system" seems to work well with ordinary grounds without resorting to elaborate buried ground wires. Often, in a congested neighborhood, having the current loop high in the air may prove advantageous from the standpoint of interference to other services.

Tests conducted last winter have been very gratifying. Others in this vicinity have copied the author's data and have been pleased with the performance. The East coast has been worked on many occasions with excellent results and in competition with very high power transmitters.

Now to 40-meter operation. On this band the antenna can be worked in two fashions, either as a conventional center-fed antenna or as a vertical. As a center-fed system it operates with a gain of about 3 db and is directional North and South with practically no radiation along the axis of the flat-top portion. It operates as two half-wave antennas. See Fig. 1C. To work North and South, as well as East and West, the transmission line is tied together at the antenna coupler (Fig. 1D). In most cases a ground will not be necessary where the transmitter is already grounded and reasonably tight coupling exists at the coupling unit. In other cases, experimentation may be necessary, first trying a ground at one end of the coil. If it loads better without the ground at this point, the ground should be omitted. An effective r.f. ground results from the series capacity in the form of distributed capacity between the link winding which is grounded and the resonant circuit to which it couples.

On 40 it radiates as a half-wave vertical radiator with the horizontal section doing little radiating and acting like half-wave ground planes. Good low-angle performance is possible. Contacts on 40-meter phone into Central and South America were made from this location.

On 10-, 15-, and 20-meters the antenna is not worked as a vertical. The transmission line is conventionally parallel-tuned to resonance and the radiation path is along the axis of the horizontal flat-top. There is some gain in these directions since the antenna performs as a long wire. Consistent performance on 15- and 20-meters into the East coast are made weekly from the author's location at Bremerton, Washington.

While the idea presented here is not new an attempt has been made to call your attention to a technique which may have gotten lost in the scramble for newer and better antennas. This antenna is hard to beat.

[EDITOR'S NOTE: *75-meter center-fed dipoles, using either 300-ohm lines or coaxial cables, may be used to good advantage (40- and 80-meters) as verticals using the same techniques as described in this article.*]

—30—

Spot Radio News

(*Continued from page* 18)

from an invention of scientists at the Institute, the item is a small (dime size) flexible condenser for measuring pressure. The variable condenser is connected to a bridge so that the output voltage is proportional to the pressure, which can be read on a meter, oscilloscope, or recorded. It can give a precise measurement of steady or fluctuating pressures ranging from a few ounces to 100 pounds-per-square-inch. When a number of these condensers are arrayed in a *blanket*, it becomes possible to chart pressure contours over a larger area.

The *filpip* was originally developed for use by the Army Quartermaster Corps, to find the points on a soldier's body where, because of straps, cuffs or boots, his clothing presses against his skin. The Quartermaster can use this information to redesign clothing and equipment that will be more comfortable, durable, and offer greater protection to the GI. *Filpip* is also finding other important uses. The Veterans Administration, for instance, has begun to use these ingenious units to measure the pressure of sockets in artificial limbs to assure a better fit and more comfort.

In a manual tracking device, designed to improve the speed and accuracy with which machine operators can correct visual error signals, electronics has also been applied effectively at the Institute's labs. An important research tool, that is outwardly similar to the more familiar reaction-testers, the device operates on the principle that a control system with long lags between manual corrections and their observed effects can be substantially improved by feeding forward into a display (on a scope) information about the instantaneous position of an operator's hands. This is typical of the manner in which engineering psychologists help to design machines that men can operate more efficiently and with less training.

Also on view at the labs is a two-coil transducer, developed to solve problems of machine design and analysis. The need for this instrument arose, Institute authorities said, when projects called for precise measurements of the deflection of a metal plate being deformed very rapidly and also the measurement of the movement of railroad tracks and ties as trains passed. In both instances, commercially-built instruments were not available or adaptable. The double-coil affair, thus evolved, has been found to have the sensitivity of standard transducers; however, it is linear with a range up to six inches. Both coils have soft iron cores; one is the motion-sensitive element and the other is the zero-balancing element.

AT THE BUREAU OF STANDARDS, in Washington, research on the appli-

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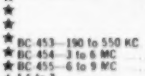

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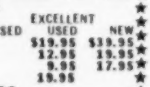

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cation of semiconducting diodes has led to the development of a new class of amplifiers that utilizes the reverse transient phenomenon of these two-element devices. Devised by A. W. Holt of the Bureau, the diode amplifier, using no vacuum tubes and achieving power gains up to 10 per stage, is said to promise important applications in the future design of high-speed electronic digital computers. To illustrate, it can be used as a pulse-repeater stage in varied types of flip-flop circuits, or as a wide-band, flat-response amplifier. Because suitable diodes are now in regular production, commercial applications are quite practical at present.

The basic requirement of the diode amplifier is that it be supplied with power from an r.f. source whose frequency is the same or higher than the modulating signal frequency. This requirement puts the circuit in the same category as magnetic and dielectric amplifiers.

A semiconductor diode of the germanium or silicon type has two static conditions; a forward conducting state, characterized by high conductivity, and a reverse conducting state, characterized by low conductivity. The forward state is achieved by applying a biasing voltage, so that the anode is more positive than the cathode, while the reverse state is achieved by applying a voltage of opposite polarity. The forward voltage acts to create a steady supply of *carriers* of current within the semiconducting material, thus maintaining a condition of high conductivity. Carriers are not created during the reverse static state.

Although amplification in the diode is not a continuous phenomenon, the action can be likened to the way in which amplification is obtained in a transistor. In the transistor, the emitter can be regarded as a diode existing in the forward conducting state, and the collector as a diode in the reverse state. If any of the carriers created by the forward-biased diode are transported to the vicinity of the reverse-biased diode, a larger current than the static current will flow in the latter diode.

Voltage on the emitter of a transistor, it has been found, produces current which creates carriers. It is these carriers which change the current in the collector and, in turn, change the voltage across the collector. In the case of a junction transistor used in the common base circuit, the collector current is almost equal to the emitter current, so that the power gain is effectively determined by the ratio between the forward and reverse resistances. Thus, power can be obtained by a transfer of current from one circuit of low impedance to another circuit of high impedance.

At the labs, it was found that the diode amplifier obtains its power gain in a similar manner, except that one electrode serves as both emitter and collector, but at different times. During one-half of the cycle, the anode is more positive than the cathode, and

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the anode acts as the emitter of the junction transistor; during the other half cycle, the anode acts like a collector. When it is an emitter, it injects carriers into the germanium with a small applied forward voltage at a low impedance level. When it is a collector, the anode withdraws these same carriers, but only by applying a much higher voltage at a higher impedance level.

In a study of the diodes suitable for amplifiers, it was found that silicon junction types have a much faster transient recovery than germanium junction diodes, and thus can be used in faster circuits. In experiments at the Bureau to study the usefulness of the silicon diode as a diode amplifier, a current-doubler type of flip-flop operated satisfactorily with a clock frequency of 25 megacycles; the circuit exhibited start-stop times of about 100 millimicroseconds. (A clock is the r.f. supply, which not only acts as the power source, but also as the switch which controls the two separate phases of the amplification cycle; the intake of signal power into the amplifier diode (injection of carriers) and the output of amplified power (decay of carriers).) According to specialists at the Bureau, it should be possible to achieve much higher frequencies by using diodes with even shorter decay times. This, it was felt, promises to provide very fast, practical circuitry for future use in electronic computers and many other useful applications.

THE VETERANS ADMINISTRATION INVESTIGATION Service in Washington has also found solace in electronics, with a magic eye device that helps document analysts in the Identification and Detection Division perform their job faster and at lower costs.

The magic eye allows lab technicians to check papers containing scratchouts, obliterations, erasures, alterations, and the like at a glance. It works equally well for ink, pencil, and typewriter. Thus any alteration by an unauthorized person, attempting to obtain a veteran's GI insurance proceeds, stands out clearly under the magic eye.

Previously detection was an expensive, time-consuming process. A special infrared photograph had to be taken and considerable time was spent in determining the area to photograph, getting proper lighting and exposure. Results were not always satisfactory.

Under the new system, when a document is placed under the magic eye, any alteration becomes visible immediately. The new electronic device works by expanding the eye's ability to see beyond its normal range of vision. One might say that it is sort of a TV camera with an electronic lens and an infrared filter; the lens focuses infrared rays which otherwise are invisible. VA experts say that the electronically-beamed infrared light heightens even slight differences in ink, pencil or typewriter; for instance if a signature has been changed, the light reveals the signature as it originally existed.

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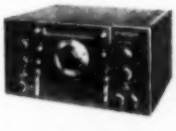

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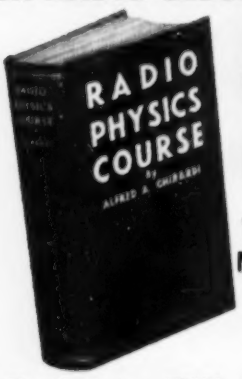

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The infrared magic eye actually was born during World War II; it was used then to help snipers track down the enemy at night. Portable electronic tubes were mounted in rifle telescopes and used in conjunction with infrared spotlights. By turning on this source of invisible light, snipers could see without being seen.

BRIEFS ASKING for competitive-allocation decisions, channel changes, application dismissals, power and antenna shifts, and so on, continued to plague the FCC examiners during the late summer and early Fall months. As a result, few grants were issued. Approvals issued to date appear below.

IN A BOLD FORECAST, *RCA's* board chairman, Brig. Gen. David Sarnoff, recently told TV affiliate representatives that we won't recognize the TV equipment of a decade hence; we'll have tubeless sets by then. All debates about one-gun and three-gun tubes, rectangular, round, glass and metal envelopes, or shadow mask and focus mask and other kinds of masks will belong, he predicted, to a language of the past.

In the future, the broadcasters were told, the picture tube will be replaced by an electro-luminescent screen on the wall and of whatever size or color we wish to make it. And that screen, it was noted, will be connected to a small box, which will contain all of the tuning, volume, and selector controls. Those tiny wonders, the transistors, he added, will replace our present lot of tubes. Yes, he emphasized, there's a glorious future ahead for the world of electronics. . . . L.W.

NEW TV GRANTS SINCE FREEZE LIFT

Continuing the listing of construction permits granted by FCC since lifting of freeze. Additional stations will be carried next month.

STATE	CITY	CALL	CHANNEL	FREQUENCY (mc.)	POWER* (Video)
Florida	Tampa	.....	8	180-186	316
Indiana	Notre Dame (Channel assigned to South Bend)	.....	46	662-668	164
Nebraska	Scottsbluff	.....	10	192-198	12.3
Texas	Beaumont	.....	6	82-88	100

NEW CALL LETTER ASSIGNMENTS

Arizona	Phoenix	KTVK	3	60-66
Minnesota	Minneapolis	KEYD-TV	9	186-192
Mississippi	Columbus	WCBI-TV	4	66-72
Nebraska	Lincoln	KOLN-TV	10	192-198
Oregon	Portland	KLOR	12	204-210

*ERP = (effective radiated power, kw.) . . = Call letters to be announced

NEW TV STATIONS ON THE AIR

(As of October 25, 1954)

The following new stations bring the lists published in previous issues up to date.

STATE, CITY	STATION	CHANNEL	FREQUENCY RANGE (IN MC.)	VIDEO WAVELENGTH (IN FT.)	VIDEO POWER (IN KW.)
California					
Stockton	KOVR	13	210-216	4.65	144
Connecticut					
Hartford	WGTH-TV	18	494-500	1.99	163
Louisiana					
Alexandria	KALB-TV	5	76-82	12.74	28.2
Lake Charles	KPLC-TV	7	174-180	5.61	52.5
Maine					
Bangor	WTWO	2	54-60	17.8	14.1
Missouri					
Joplin	KSWM-TV	12	204-210	4.79	58
New York					
Carthage-Watertown	WCNY-TV	7	174-180	5.61	172.6
South Carolina					
Charleston	WUSN-TV	2	54-60	17.8	100
Florence	WBTW	8	180-186	5.43	316
Texas					
Tyler	KLTV	7	174-180	5.61	100
Washington					
Spokane	KREM-TV	2	54-60	17.8	100
West Virginia					
Oak Hill (Beckley)	WOAY-TV	4	66-72	14.61	48.45
Canada					
Sydney, N. S.	CJCB-TV	4	66-72	14.61	100
Kingston, Ont.	CKWS-TV	11	198-204	4.93	257
Windsor, Ont.	CKLW	9	186-192	5.25	325

KUSC-TV (Ed.), channel 28, Los Angeles, California; WTAC-TV, channel 16, Flint, Michigan, have gone off the air.

The frequency of the video carrier = 1.25 + channel lower freq. limit. Total number of TV stations now on the air in U.S.: 405 (123 of which are u. h. f.)

DO YOU KNOW....?

Test your knowledge of progress in home music from records, tape, and FM radio. Whether you are a Music Enthusiast or an Audio Perfectionist, you should be able to answer all the questions in these six groups. Can you?

JAZZ MUSIC:

1. What is Louis Armstrong's first name?
2. When and where did what orchestra leader introduce "swing" music?
3. What happened in New Orleans in 1917 that affected the whole future course of jazz music?
4. Why and how did the New Orleans jazzmen go to Chicago?
5. How was jazz affected by 1) the last war, 2) broadcasting, and 3) taxes?
6. What recent event gave a tremendous impetus to public interest in jazz?
7. What 20 records make up a basic library of authentic jazz music?

PRE-RECORDED TAPE:

1. Why are pre-recorded tapes becoming popular with people who want the very top quality of reproduction?
2. If the audio quality from pre-recorded tape is not as good as you expected, where does the trouble probably lie?
3. Has suitable equipment been perfected for making perfect copies from the master tape recordings?
4. What companies are making the new pre-recorded tapes?
5. What are the 4 features of tape that offer important advantages over discs?
6. How many times can one tape be copied from another before there is audible evidence of deterioration in quality?
7. Where can reviews of pre-recorded tapes be found?

NEW EQUIPMENT:

1. Why haven't FM broadcast receivers been manufactured for use in automobiles, and has a successful set ever been developed for this purpose?
2. What new tuner was so designed that most of the wiring is done with a single printed-circuit panel?
3. What simple method can be used to tell exactly when a diamond stylus has been used for 500 hours of actual playing time?
4. With what special project was Major Armstrong principally concerned during the last years of his life?
5. Can you name 6 important audio components brought out this fall, and identify the manufacturers?
6. Is there a better way to broadcast binaural programs than to use AM for one channel, and FM for the other?
7. When a sapphire stylus is worn out, is it practical to have it replaced with a diamond?

PHONOGRAPH RECORDS:

1. What world-famed orchestra recently made a record that will be given away, but cannot be bought?
2. Where can you find record reviews grouped by types of music, prepared by specialists in each type, for the guidance of record collectors?
3. What company manufactures 78 rpm records to be played with an LP stylus?
4. Can you make up a list of records that will hold the attention of a group of small boys and girls for 90 minutes?
5. How many musicians were there in Toscanini's orchestra; how many can you name; what instruments did they play?
6. What kind of music by which composers not previously recorded will be featured in next year's releases?
7. Where do the producers of TV shows get most of their background music?

REPRODUCTION FROM TAPE:

1. On an A-B test of monaural and binaural reproduction, what are the two important differences?
2. After how many hours of use must the heads of a tape recorder be replaced?
3. How wide is the slot on a recording head? Can you actually *see* the slot?
4. Who is producing binaural pre-recorded music tapes?
5. If you own a fine speaker system, what types of speaker, or speakers, would you add for playing binaural tapes?
6. What is wrong when pre-recorded tapes do not sound right on your tape machine, yet results are excellent when you play back tapes you recorded yourself on the same machine?

MISCELLANEOUS SUBJECTS:

1. What type of speaker enclosure is designed specifically for reproducing frequencies below 200 cycles?
2. Where can you find a complete list of the leading dealers specializing in hi-fi equipment?
3. Where can details be found for an automatically-tuned FM receiver using separate crystal controls for each desired station?
4. What instrument makes it possible to actually *see* the difference between the two channels being fed to a binaural speaker system?
5. How can you have catalogs and literature sent to you by leading audio equipment manufacturers without writing letters or using even one postage stamp?
6. Where can you get "inside information" on the design and construction of new audio equipment?

ALL THE ANSWERS:

You should be able to answer all the questions in at least four of the groups on this page. All the answers, and the answers to many, many more questions are contained in the current issue of MUSIC at HOME, the magazine published for both music Enthusiasts and Audio Perfectionists.

MUSIC at HOME is a tremendously interesting, fast-growing magazine, filled with articles by top authorities in the fields of music, hi-fi equipment, and custom installation. It is a large-size publication, elaborately illustrated, and printed on fine paper. You'll get a world of enjoyment and a fund of fascinating ideas from every issue. Use the coupon below to order a subscription right away. And remember that MUSIC at HOME makes a most welcome holiday gift!

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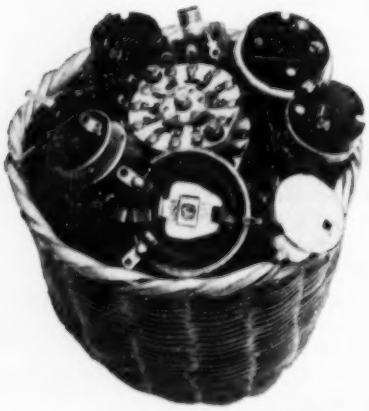

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stituted without any change in circuit values, despite the fact that it has a higher gain. Performance will be almost as good as with a 12AY7.

The tone control circuit shown within the dotted box in Fig. 5 incorporates separate bass and treble controls with separate switches from boost to cut. This type of tone control circuit was originally proposed by D. T. N. Williamson. It was used here because it is simple to construct and gives adequate amounts of boost and cut on both bass and treble. The maximum boost and cut, for both bass and treble, are shown in Fig. 3. A unique feature of this tone control is that there is a definite position where the listener can be sure that he has flat response. This position is when both the bass and treble control pots have the tap at the extreme left (counterclockwise) position.

The second half of the 12AY7, V_{1B}, is fed from the tone-control circuit and serves to bring the signal to the level it had before entering the tone control and provide isolation between the tone control and the volume control.

The power supply components shown in the schematic, Fig. 5, give an indication of the small amount of power drain of the amplifier. It uses a 260-0-260 volt power transformer, T_1, with a rating of only 90 ma. The 6.3 volt winding supplies the heaters of all the tubes including the 6X4 rectifier. It also supplies the pilot light, PL_1. The transformer used includes a 5 volt winding which is not used and should be taped. The author used a 12 henry, 100 ma. filter choke for CH_1 because one was available. Any value from 6 to 15 henrys would be suitable. If a choke is not available, a 200-ohm, 10-watt wirewound resistor can be used instead. A 39-ohm, 2-watt surge limiting resistor, R_{39}, and a 100,000-ohm, 2-watt bleeder, R_{38}, are also used. The total power drain is about 20 watts of plate power plus about 15 watts of heater power or a total of 35 watts, which is less than that drawn by the average home radio.

The output tubes are 6AR5 power pentodes. These tubes were selected because they can be run at a high negative bias with low plate current drain. Therefore, since there is plenty of amplification and a large signal, the output tubes can be driven hard and draw only small plate current. The tubes are run at a bias of —30 volts, which is class AB_1 operation. If 6AR5 tubes should prove difficult to obtain, 6K6 tubes can be substituted directly since they have the same characteristics. A 100-ohm pot, R_{36}, is provided for balancing the cathode currents of the two output tubes. The plate-to-plate load of the output tubes should be 14,000 ohms.

One of the advantages of this particular amplifier is that the choice of a suitable output transformer is not critical. It goes without saying, however, that the amplifier will function better

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with a good quality output transformer but it will do quite well with a unit of the p.a. type. The reason for this is that since the circuit incorporates pentodes as the output tubes, with more gain than triodes, the effect of a given fraction of the output voltage fed back is greater. This is equivalent to increasing the feedback. The advantages of feedback, of course, are well known, namely, the extending of the frequency response, the lowering of the per-cent of distortion, and the effect of making a given circuit less dependent on the components. Since the feedback has been effectively increased, the amplifier becomes less dependent on the characteristics of the output transformer. A transformer with a bandwidth of 50 to 13,000 cps at the 3 db points will give good results. A *UTC* Type CG-710 is satisfactory for T_2.

Construction

The amplifier was built on a 7" x 12", x 2" standard aluminum chassis. The maximum vertical dimension, with all components mounted, is 7". The amplifier can be constructed in a variety of ways, depending on the builder's wishes. The location of the top-of-the-chassis components is indicated in Fig. 1. Front panel controls, shown in Fig. 1, include the treble control, treble switch, bass control, bass switch, volume control, and "on-off" switch. The balancing pot is mounted on top of the chassis. The input connectors are on the side of the chassis while the fuse and speaker connections are at the rear. The ground leads should all be connected to a bus bar which is grounded to the chassis at the input connector. Note that the power supply is as far removed from the input stage as possible. Also note that the output tubes and the output transformer are at an appreciable distance from the inputs. Whenever possible, leads should be crossed at right angles. All leads should be as short as possible and the input cable should be shielded.

Test Results

The response curve, Fig. 4, was obtained using a sine-wave generator and an oscilloscope. The harmonic distortion was measured using a bridged-T filter so connected as to filter out the fundamental component of the signal. The harmonics were measured using the filter connected in such a way that each harmonic could be measured individually. Since this is a push-pull system, even harmonics should be non-

Table 1. Harmonic distortion of the amplifier-preamp at three frequency ranges.

FREQUENCY	POWER OUTPUT	% DISTORTION
	1	.4
50	8	1.2
	1	.2
5000	8	.9
	1	.5
15,000	8	1.4

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1H5GT	.38	6AQ6	.36	6CB6	.45	6X4	.39	19BG6G	1.15
1L4	.50	6AQ7	.68	6CD6G	1.15	6X5GT	.35	19T8	.75
1N5GT	.62	6AR5	.45	6F6	.45	7E6	.40	25BQ6GT	.75
1R5	.48	6AS5	.50	6H6	.53	7X6	.58	25L6GT	.45
1S5	.40	6AT6	.39	6J5	.40	7L7	.77	25W4GT	.45
1T4	.48	6AU4GT	.70	6J6	.50	12AL5	.40	35A5	.49
1U4	.48	6AU5	.82	6K6GT	.39	12AT6	.35	35B5	.38
1U5	.40	6AU6	.45	6L6	.62	12AT7	.65	35C5	.38
1X2	.65	6AV6	.39	6R7	.49	12AU6	.38	35L6GT	.45
3A4	.45	6AX4GT	.59	6S4	.39	12AU7	.55	35W4	.45
3Q4	.48	6BA6	.40	6S8GT	.81	12AV6	.50	35Z5GT	.45
3Q5GT	.48	6BA7	.57	6SA7GT	.41	12AV7	.60	45	.53
3S4	.48	6BC5	.49	6SB7Y	.76	12AX4GT	.55	50B5	.41
3V4	.50	6BD6	.45	6SC7	.59	12AX7	.58	50C5	.41
5U4G	.55	6BE6	.39	6SD7GT	.39	12BA6	.40	50L6GT	.59
5Y3GT	.39	6BF5	.55	6SK7GT	.39	12BA7	.57	70L7GT	1.07
5Y4G	.39	6BG6G	1.20	6SL7GT	.49	12BE6	.41	76	.42
6AB4	.42	6BH6	.45	6SN7GT	.55	12BH7	.65	81	1.25
6AF4	.92	6BJ6	.41	6SQ7GT	.37	12BY7	.65	117L7GT	1.19
6AF6	.75	6BK7	.89	6T8	.75	12BZ7	.65	117P7GT	1.39
6AG5	.49	6BL7GT	.65	6U7	.56	12SL7GT	.49	117Z3	.39
6AH4	.67	6BQ6GT	.77	6U8	.59	12SN7GT	.50	807	1.25
6AK5	.59	6BQ7A	.92	6V6GT	.45	12SR7met	.55		

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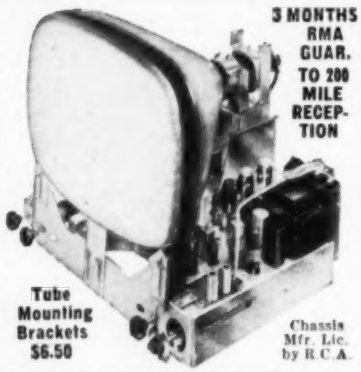

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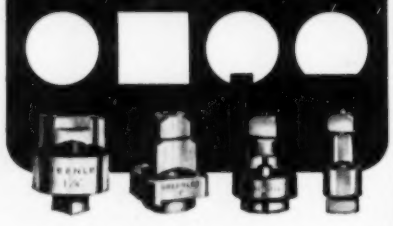

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372	394	415	438	502	523	440	462	6378						
374	395	416	441	503	525	441	463	6450						
375	396	418	483	504	526	442	464	6470						
376	397	419	484	505	527	444	465	6497						
377	398	420	485	506	529	445	466	6522						
379	401	422	486	507	530	446	468	6547						
380	402	423	487	508	531	447	469	6610						
381	403	424	488	509	533	448	470	7350						
383	404	425	490	511	534	450	472	7360						
384	405	426	491	512	536	451	473	7393						
385	406	427	492	513	537	452	474	7480						
386	407	429	493	514	538	453	475	7580						
387	408	430	494	515		454	476	7810						
388	409	431	495	516		455	477	7830						
390	411	433	496	518		457	479							
391	412	435	497	519		458	480							
392	413	436	498	520		459								

CR-	FT171B BC-610 2 Banana Plugs ½" SPC			
1A	2030	2220	2360	3202 2945
SCR 522	2045	2258	2390	3215 3955
½" P	2065	2260	2415	3237 3995
½" S	2082	2282	2435	3250
	2105	2290	2442	3322
	2125	2300	2532	3510
	2145	2305	2545	3520
	2155	2320	2557	3550

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existent if the output stage is balanced. If the system is appreciably unbalanced, these harmonics will appear. If the amplifier is found to be unbalanced, the balancing pot can be used to correct this condition. It was found that all harmonics above the fifth were practically non-existent.

The power due to the harmonics was measured as $(E^2_3 + E^2_5)/R_L$. The harmonic distortion P_5/P_1 was found using this method. Table 1 gives the results obtained. The intermodulation distortion was measured using an intermodulation analyzer, the frequencies of the two signals being 60 and 7000 cps. The distortion measured at power levels of 1 and 8 watts was .5 per-cent and .9 per-cent respectively. The hum level was found to be 75 db down from the full rated signal. —30—

Within the Industry

(Continued from page 32)

COMPANY has moved its New York offices to 589 Fifth Avenue . . . The Distributor Division of **PERMOFLUX CORPORATION** has moved to new quarters at 2835 N. Kedzie Ave. in Chicago . . . **GRAYLOCK ELECTRONICS SUPPLY CO. INC.** is now occupying its new quarters at 554 W. 168th St. in New York.

* * *

CHARLES W. HOSTERMAN has been named to the newly-created post of assistant general manager of the electronics division of *Sylvania Electric Products Inc.* He will make his headquarters at the division's Woburn Mass. plant.

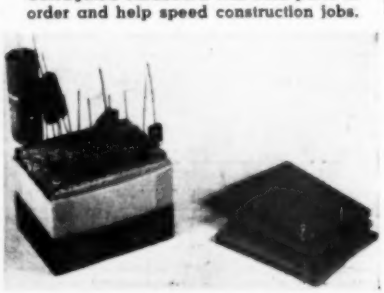
Mr. Hosterman joined the company in 1943 and since 1950 has been manager of the firm's radio tube division plant. —30—

COMPONENTS HOLDER

TAKE a corrugated cardboard box and cut it into pieces small enough to fit in a small parts box. Then, the next time you start wiring a piece of equipment, collect all the resistors, coils, condensers, and other small parts you'll need together and stand them upright in the box, as shown in the photograph.

A components holder like this one will keep all the parts neatly together, yet hold them in such a fashion that any part can be taken without disturbing the rest. . . . . L. G.

Corrugated cardboard will hold parts in order and help speed construction jobs.



CHECK R.F. COILS

IF YOU have a chance to remove the r.f. coil from a defective or obsolete radio you will find the general type similar to the coil illustrated.

There are two windings of fine wire on a heavy coated cardboard form. The one coil or primary attaches to the antenna circuit.

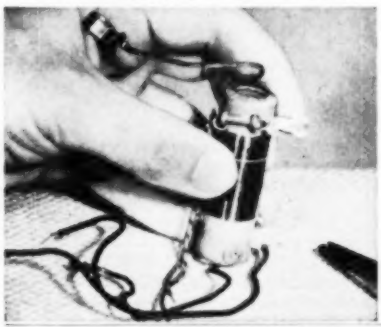
One end of the secondary coil goes to the grid (the lead with the grid cap attached) of the converter tube and the other secondary coil wire goes to a condenser and then to ground.

Tuning condensers are across this secondary coil.

There is also a resistor of several thousand ohms, usually attached directly to the coil terminal, opposite the grid end, for a.v.c.

A mounting terminal is also shown in the illustration. . . . . H. L.

A good chance to study r.f. coil construction is afforded by discarded coil units.



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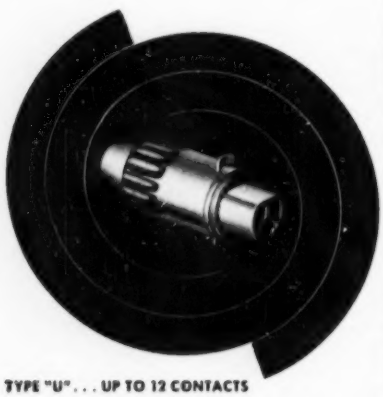

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The Electron Tube

(*Continued from page* 67)

models the perforated plate was replaced by a folded wire grid to lessen the cost. Needless to say this was the best design of all. Patent number 841,387 covering this arrangement was issued January 15, 1907, and is one of the most valuable patents ever issued.

Later, in 1909 or 1910, along with mechanical improvements, it was found that a grid and plate on each side of the filament increased its functional value. Starting with a carbon filament in the early models, tantalum and, ultimately, tungsten wire was used for the 3½ volt filament material. A picture of the 1907-1909 "Audion" with the single plate and grid is shown at the right of Fig. 2 and the improved double plate and grid "Audion" of 1910 is shown at the left. These are the earliest existing models of electronic vacuum tubes and, excepting the experimental models previously mentioned and which are known to have been destroyed, are the first in the electronics field. By way of explanation, originally in both of the tubes pictured, plate and grid wires came out of the seal at the bottom of the tube, but have long since been broken off.

With the "Audion" now a practical tube, de Forest produced an oscillating receiver for c.w. reception, and larger and heavier tubes for transmitting purposes. Its use as an amplifier of sound was demonstrated, with the telephone interests becoming involved.

The way of the inventor was not easy. As various interests learned of the new device, many started to get into the field with little or no benefit to the inventor. By 1915 there were several sources of tubes, and when the first trans-Atlantic telephone was tested, although in Paris at the time, Dr. de Forest was not allowed to witness the experiment.

The writer's collection of early de Forest tubes is shown in Fig. 1. The tubular "Audions" in the bottom row were known as Type "T" and were made first in 1915 when the spherical envelope was discontinued. It also presented a major change in sales policy, as prior to this time it was necessary to return an old bulb (tube) to purchase a new one. Competitors had been selling tubular vacuum tubes below the original de Forest price, hence his entrance into this field selling an "Audion" with the nonreturn policy. The "Ultraudion" in the middle of the bottom row is one of the earliest of the power tube models, and while not large, it did an excellent job. The middle row of tubes were the very first transmitting tubes ever made with all the leads brought out in base contacts. These were made in 1915 by de Forest in conjunction with Lt. Comdr. S. C. Hooper, USN.

Tubes from several of the early sources other than de Forest are

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shown in Fig. 5. This is in no sense a complete or near complete list of what was made in that period, but constitutes the writer's collection for that period. Fig. 3 shows the earlier development of really large triode tubes in the early 1930's and Fig. 4 is a UV 862 tube, 100 kw. rating, using 18,500 volts at 5 amps on the plate and a filament of 205 amps at 32 volts.

In this collection drawn from a total of over one thousand tubes in his possession, the writer has attempted to show how it began, and what, in a very general way, was accomplished in the capacity (size) of the triode tube. To add anything in the way of development from the screen grid tube, with its fourth element is totally beyond the scope of this article. All of this scarcely constitutes an introduction to the broad subject of electronics. —30—

PANEL LAMP USE

By JAMES A. McROBERTS

THE majority of television receivers employ a 0.25 ampere fuse to protect the high voltage components. A convenient substitute for this fuse is the pilot lamp, Mazda 47 with 150 milliamperes at 6 to 8 volts. The current drawn by the high voltage supply is ordinarily less than the amount needed to light the lamp at full brilliancy, hence it burns dim. Maladjustment of the set will result in a much higher drain however.

The lamp also serves as a linearity coil adjustment since minimum brightness—least circuit current drain through the lamp—is the correct adjustment of the horizontal linearity coil. To adjust the linearity coil with the lamp installed in place of the fuse, turn the linearity coil adjustment screw all the way out; and then turn it in, tuning for minimum brilliance of the Mazda 47 lamp. The first such minimum should be used as it is possible (on some sets) to encounter another minimum which will also yield a linear picture although the second minimum will be a minimum only for certain settings of the contrast and brightness controls. This last statement means that the linearity may change with movement of the contrast control, or the brightness control, or both these controls, and is a "false" setting.

Relatively bright illumination of the lamp at such a minimum setting of the linearity control means excessive current drain for all sets employing a single 6BG6 tube—do not use the Mazda 47 for paralleled tubes. The excess current drain may come from overdrive, leaky components, or partial short circuits in the components. Even a few turns short circuited on the flyback transformer will cause the lamp to light up very brightly contrasted to the case in which the transformer is in good condition.

There is no objection to leaving the bulb in the circuit permanently as the voltage drop is about one half of the normal rating of 6-8 volts and is practically meaningless insofar as voltage drop is concerned. For sets employing paralleled output tubes, use a bulb with a larger current rating such as Mazda 44 with a current drain of nominally 0.25 ampere at 6-8 volts. While the panel lamp is a good indicator of the relative amount of current, the cold resistance is less than the hot resistance and the brilliance is therefore not directly proportional to the current. —30—

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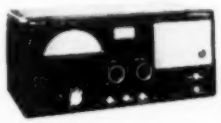

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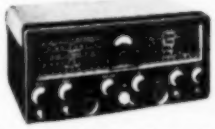

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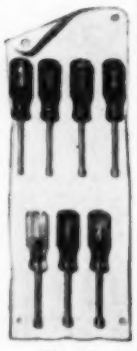

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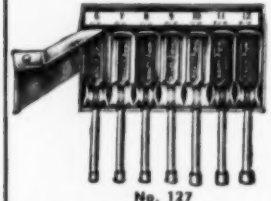

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All-Purpose Enclosure

(*Continued from page 52*)

formance-wise in the living room? Is there a cabinet that has *all three* baffle characteristics built in? There is one all-purpose loudspeaker enclosure. It is called the "Fold-a-flex" because it can be used as a folded horn, an infinite baffle, or as a bass reflex.

The "Fold-a-flex" design consists of three adjustable acoustical ports, as shown in the photo, and a built-in folded horn. The baffle can contain a mid-range horn, a high-frequency tweeter, or both. Space is also provided to mount crossover networks in two- or three-way systems. The "Fold-a-flex" cabinet permits a wide choice of mounting arrangements so that you may use a single wide-range 12" hi-fi loudspeaker. Later you can add one of the excellent tweeters and enjoy a two-way system. If you so desire, a third (mid-range) horn may be added. Thus, depending upon the amount you can invest in loudspeakers, various components can be added later.

The construction diagram of the new enclosure for 12" systems provides enough detail so that it may be assembled in any shop having the necessary power tools for the cutting of the various fins at their proper angles. The entire cabinet is constructed of ¾" plywood, and the outside pieces may be any of the many attractive veneers available from most lumberyards. Ports A and B are hinged as shown, and must be carefully fitted to provide an air-tight seal when in the open or closed position. Note that there is a half-round vinyl gasket secured completely around the two side ports to provide the necessary air seal. The adjustable slide which moves up and down in the slots is shaped so that the slide will seal off the slide openings when in the closed position. This prevents air leakage through the adjusting slots.

The baffle must be securely mounted to the all-around flange in such a manner that if it were a solid piece of wood it would make the cabinet completely air tight. The frame containing the grille cloth mounts in front of the baffle, as shown, and is used for decorative purposes only. It is simply shown for those who wish a professional-looking cabinet.

There are four braces employed, called bracket shelves. Their function is to prevent vibration of the interior fins. One of the advantages of the design is the lack of parallel-reflective surfaces. A minimum of padding will provide sufficient damping when *Kimsul* or felt is placed both at the top and bottom of the inside compartment containing the cone.

Action—Folded Horn

There are two hinged doors, A and B, which are the side ports of the enclosure. They are completely sealed by means of gaskets so that no air can

pass at their edges when placed in either of the two positions shown. When ports A and B are pushed inward, they become extensions of the inner horn structure and form the mouths of the folded horn. The enclosure may be placed against a flat wall and will provide excellent bass response, or it may be placed in a corner which will provide even greater extension of the bass response. Port C is closed when the "Fold-a-flex" is used as a folded horn.

Infinite Baffle

Ports A, B, and C are all closed which, in effect, results in a completely enclosed cabinet that is airtight. Approximately 6½ cubic feet of air loading is provided, which insures proper damping for 12" loudspeakers. This is one of the most satisfactory of all types of enclosure characteristics for single, coaxial, or triaxial loudspeakers, and has similar advantages to a loudspeaker mounted within a wall between two large rooms.

Bass Reflex

Many loudspeakers perform exceptionally well in this type of enclosure. Because the "Fold-a-flex" has an added feature of being fully adjustable to any loudspeaker, there are added advantages to this form of baffling. Ports A and B remain fully closed, the same as when used as an infinite baffle. The slide (in back of the reflex port C) is adjusted by loosening the two knobs and setting the slide to any position from a fully opened port to one which is fully closed. In practice, the port is adjusted by any of the familiar techniques in reflex port adjustment described in reference books.

In next month's article we'll show the performance curves for some of the many 12" systems measured under free field conditions. *(To be continued)*

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The Progressive Radio "Edu-Kit" offers you a home study course at a rock bottom price. Our Kit is designed to train Radio Technicians, with the basic facts of Radio Theory and Construction Practice expressed simply and clearly. You will gain a knowledge of basic Radio Principles involved in Radio Reception, Radio Transmission and Audio Amplification.

You will learn how to identify Radio Symbols and Diagrams; how to build radios, using regular radio circuit schematics; how to mount various radio parts; how to wire and solder in a professional manner. You will learn how to operate Receivers, Transmitters, and Audio Amplifiers. You will learn how to service and trouble-shoot radios. You will learn code. You will receive training for F.C.C. license.

In brief, you will receive a practical basic education in Radio, worth many times the small price you pay.

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The Progressive Radio "Edu-Kit" was specifically prepared for any person who has a desire to learn Radio. The Kit has been used successfully by young and old in all parts of the world. It is not necessary that you have even the slightest background in science or radio.

The Progressive Radio "Edu-Kit" is used by many Radio Schools and Clubs in this country and abroad. It is used for training and rehabilitation of Armed Forces Personnel and Veterans throughout the world.

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The Progressive Radio "Edu-Kit" comes complete with instructions. These instructions are arranged in a clear, simple and progressive manner. The theory of Radio Transmission, Radio Reception, Audio Amplification and servicing by Signal Tracing is clearly explained. Every part is identified by photograph and diagram. You will learn the function and theory of every part used.

The Progressive Radio "Edu-Kit" uses the principle of "Learn by Doing." Therefore you will build radios, perform jobs, and conduct experiments to illustrate the principles which you learn. These radios are designed in a modern manner, according to the best principles of present-day educational practice. You begin by building a simple radio. The next set that you build is slightly more advanced. Gradually, in a progressive manner, you will find yourself constructing still more advanced multi-tube radio sets, and doing work like a professional Radio Technician. Altogether you will build fifteen radios, including Receivers, Transmitters, Amplifiers, Code Oscillator and Signal Tracer. These sets operate on 105-125 V. AC/DC. An Adapter for 210-250 V. AC/DC operation is available.

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You will receive every part necessary to build 15 different radio sets. Our kits contain tubes, tube sockets, chassis, variable condensers, electrolytic condensers, mica condensers, paper condensers, resistors, line cords, selenium rectifiers, tie strips, coils, hardware, tubing, etc.

Every part that you need is included. These parts are individually packaged, so that you can easily identify every item. A soldering iron is included, as well as an Electrical and Radio Tester. Complete, easy-to-follow instructions are provided.

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Trouble-shooting and servicing are included. You will be taught to recognize and repair troubles. You will build and learn to operate a professional Signal Tracer. You receive an Electrical and Radio Tester, and learn to use it for radio repairs. While you are learning in this practical way, you will be able to do many a repair job for your neighbors and friends, and charge fees which will far exceed the small cost of the "Edu-Kit." Here is your opportunity to learn radio quickly and easily, and have others pay for it. Our Consultation Service will help you with any technical problems which you may have.

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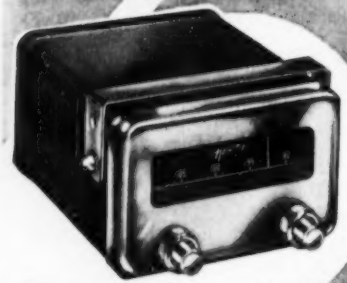

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MANUFACTURERS' LITERATURE

The various listings presented in this section are for your convenience. The bulletins, unless otherwise indicated, are available to all our readers. For prompt attention write directly to the manufacturer for this literature.

TRANSFORMER LAMINATIONS

Two new catalogue pages on 1¾" E and I transformer laminations are now available from *Tempel Manufacturing Company*, Bryn Mawr at Damen, Chicago 26, Illinois.

Complete technical data is listed, including dimensional drawings, stacking factor, specifications, weight, and count. The Type T-175 RH lamination features the new RETMA corner mounting holes while the Type T-175 H has standard mounting holes.

LINEAR CATALOGUE

Linear Equipment Laboratories, Inc., Brightwater Place, Massapequa, Long Island, N.Y., has just issued an elaborate new catalogue which contains data sheets covering its line of test equipment and TV accessories.

Included is information on an oscilloscope probe for color TV, a square-wave generator, a noise figure test set, a video line amplifier for color TV, terminations, a u.h.f. transformer, v.h.f.-u.h.f. baluns, a u.h.f. wavemeter, a u.h.f. grid-dip oscillator, and reflection boxes for u.h.f. and v.h.f.

INVENTORY CHART

The Pyramid Electric Company of North Bergen, N. J. has released a 16-page combination inventory record and interchangeability chart.

Created as an aid to dealers who carry the company's condensers, the booklet includes space for a six-month inventory period and lists the major types of condensers and their interchangeability factors.

SOLDER HANDBOOK

Kester Solder Company, 4201 Wrightwood Avenue, Chicago 39, Ill., is now offering a 78-page textbook on the subject of solder.

Available to manufacturers, laboratories, design engineers, government agencies, universities, vocational institutions, and qualified individuals, the new book provides the solder user with a scientific study of the industrial application and usage of the product. Charts, tables, and photographs are used lavishly.

Write Dept. TP of the company for a copy of this new reference work.

MOBILE ANTENNAS

Antenna Specialists Company, 12435 Euclid Ave., Cleveland 6, Ohio, has issued a 6-page catalogue describing a line of mobile communication and ground plane antennas regularly stocked by the firm.

The brochure pictures and describes bases, shock-mounting springs, antennas, adapters, and antenna rods. A copy of this catalogue is available on request, as is information on the company's specialized production antenna line.

ASTATIC CATALOGUE

A new, complete products catalogue has just been issued by *Astatic Corporation* of Conneaut, Ohio.

Included among the stock items listed in the new publication are phono pickups and needles, recording heads, microphone stands, TV u.h.f. converters, and boosters.

Complete specifications, performance data, and replacement details are featured in this concise publication.

GERMANIUM DIODE DATA

International Rectifier Corporation, 1521 E. Grand Ave., El Segundo, California, is now offering a new 4-page bulletin which lists ratings and specifications on the company's germanium diodes.

Included in Bulletin GD-1A is a complete replacement guide of the company's diodes for replacing RETMA type diodes and ratings and characteristics on the new "Red Dot" line for 100 degree C applications.

REMOTE CONTROL WIRING

The Construction Materials Division of *General Electric Company*, Bridgeport, Conn., has issued a completely revised, up-to-date edition of its remote-control wiring manual.

The manual, 16-284, includes the new components recently added to the company's line, such as relay gang boxes, motor-driven master switch, new locking switches, and new twisted construction, color-coded remote-control wire.

Wiring diagrams, wiring layouts, suggested specifications, and other useful information is also provided in this free manual.

INTERFERENCE TESTERS

Empire Devices Products Corp., 38-15 Bell Boulevard, Bayside 61, N. Y., has recently issued a 6-page catalogue describing its line of noise meters, distortion analyzers, impulse generators, attenuators, and crystal mixers.

This comprehensive catalogue is fully illustrated and details for each product data on design specifications, operating ranges, recommended applications, and lists of accessories.

STANCOR REPLACEMENTS

The *Stancor Division* of *Chicago Standard Transformer Corporation*,

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J-47 TELEGRAPH KEY—NEW **$0.97**

BC-221 TECHNICAL MANUAL—NEW **$1.25**

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WESTINGHOUSE NA-37—0-200 A.C. AMMETER—2% accuracy—Magnetic Vane movement—50 scale div.—F.S. 5 amps—3⅛" round body—4 9/16" round flange—50-1 Ext. current xfmr. (not included) NEW—Boxed **$7.95**

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Addison and Elston, Chicago 18, Ill., has issued two new bulletins covering replacements for TV flybacks.

Bulletin 492 lists the *Muntz* and *RCA* applications for these new units while *Airline* and *Sentinel* applications are listed in bulletin 493.

Either or both of these bulletins are available without charge from the company's distributors or the company direct.

NEW RCA TUBE MANUAL

A revised edition of the "*RCA* Receiving Tube Manual" which provides basic technical data on more than 500 entertainment-type tubes used in radio, TV, and sound equipment is now available, according to the Tube Division of *Radio Corporation of America*.

Sixty-seven new tube types are listed in the manual. Pertinent technical information for the 536 tubes contained in the book is amplified by line drawings, socket diagrams, and characteristics curves.

The book also provides new hi-fi amplifier circuits, including a bass and treble tone-control stage, a low-distortion input stage, a 2-stage input amplifier with cathode-follower output, and a preamplifier stage.

Copies are now available from *RCA* tube distributors at $.60 each.

TRANSFORMER CATALOGUE

The *Chicago Division* of *Chicago Standard Transformer Corp.*, 3501 Addison St., Chicago 18, Illinois, has announced the publication of its new transformer catalogue, CT-554.

This 32-page book contains detailed descriptions of over 500 stock transformers for military, new equipment, general replacement and power and control circuit applications. A simplified classification system makes it easy to locate any particular unit and the dimensions of all cased units are shown diagrammatically.

Broadcast high-fidelity transformers, miniature audio transformers, and ultra-π.iniature transistor transformers are just some of the new units listed in this catalogue.

"DE-SNOWER PREAMPLIFIER"

Data on the company's new "De-Snower Preamplifier" is included in the four-page illustrated brochure just released by *Jerrold Electronics Corporation*, Dept. 823, 26th and Dickinson Streets, Philadelphia, Pa.

The brochure covers three models of the new broadband antenna-mounted preamplifier and provides data on inputs, output, tube complement, size, shipping weight, and list prices.

1955 TV "BLUE BOOK"

The all-new "1955 TV Blue Book" is now available for distribution, according to the publisher, *National Appliance Trade-in Guide Company*, 2132 Fordem Ave., Madison 1, Wisconsin.

Special features include all new trade-in values based on present market conditions and the new lower list prices. An accurate analysis of the

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NEW VOLUME 4

Covers 50 chassis (62 models) produced during 1953. Complete coverage includes schematics, chassis photo views, replacement parts data, service hints, etc. 288 pages. 8½ x 11".

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NEW VOLUME 5

Covers 37 amplifiers, 12 preamplifiers and 14 tuners made in 1952, 1953. Complete analysis based on lab study: circuit diagrams, chassis photo views, parts data, full coverage. 352 pages, 8½ x 11".

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Vol. 3. Covers 50 amplifiers and 22 tuners made in 1950. 352 pages, 8½ x 11". Order **AA-3.** Only **$3.95**

Vol. 2. Covers 104 amplifiers and 12 tuners made in 1949. 368 pages, 8½ x 11". Order **AA-2.** Only **$3.95**

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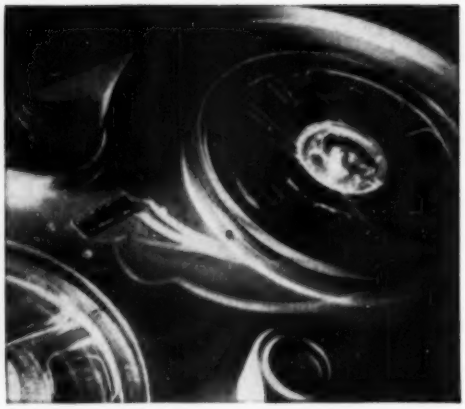

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16AP4A	30.95	16KP4	17.50
16DP4A (N.U.)	29.25	16DP4 or A	17.50
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16KP4, 16MP4	24.30	16CP4 or A	17.50
16KP4A (Aluminum)	28.35	16FP4	17.50
16JP4A (N.U.)	25.25	16WP4	17.50
16SA	25.50	16AP4A	17.50
16WP4A	26.50	16DP4A	23.00
16GP4B	31.25	16EP4	19.00
17BP4A	24.25	16EP4A	23.50
17BP4B	30.30	16GP4 or A	21.00
17CP4	34.00	17BP4	18.50
17CP4B (Aluminum)	38.50	17CP4A	21.60
19AP4A	41.50	17GP4B	22.60
20CP4	30.00	19FP4	23.60
20GP4	37.50	19FP4A	24.00
21AP4	42.00	19AP4	23.90
21BP4	31.80	19AP4A	24.50
21EP4A	36.35	20CP4	23.55
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1955 TV market, showing the dealer what and how to buy, and the section on trade-in merchandising make this issue of special interest.

Write the publisher for single and quantity prices on the guide.

SERVICE PARTS DIRECTORY

The Tube Division of *Radio Corporation of America*, Harrison, N. J., has announced the availability of a comprehensive "Service Parts Directory" containing basic service and parts replacement data for all 1952 model *RCA Victor* home TV receivers.

Designed to meet the service needs of dealers and technicians, the 36-page directory (SP-1021) includes schematic diagrams, wiring diagrams, parts lists, top and bottom chassis views for 27 different *RCA* table model and console receivers.

The directory is 50 cents a copy and is available from the company's parts distributors or the company direct. A directory covering 1953 model receivers is currently in preparation. —30—

NOSTALGIA FOR O.T.'s

WE HAVE had a long, interesting letter from T. Baker of Tilton on the Hill, Leicestershire, England recounting some of his earliest experiences in "wireless." We would like to share some of the highlights with our readers who can remember "way back when."

Mr. Baker joined the General Post Office on the telegraphic side in 1912 but transferred to the wireless branch of the Royal Navy in 1915. He recalls the wonderful discussions on the advantages of various spark gaps. One big transmitter of 25 kw. had an adjustable spark gap which started off at 5 mm. but, by turning a handle, this gap could be increased to 25 mm. The gap was enclosed in a box and a current of air blown over it. It made a terrific noise and could be heard about a mile away while the range of the set was several thousand miles.

Transmitting was accomplished by making and breaking the circuit of the primary of the high-voltage transformer by means of a magnetic switch with eccentrically mounted contacts that could be adjusted for wear.

He recalls that he used a 25 kw. tube transmitter during the last war which used the same switch and the original alternators. With this equipment he communicated with England direct from the China Sea.

In 1925 he had his first superhet. It consisted of seven tubes, all of which were identical and were bright emitters. The first tube was known as the antenna isolator (r.f. amplifier), the second and third together were the mixer, the inductances being tuned by separate condensers which could be rotated 360 degrees so each station could be tuned in on two positions on each dial. The fourth, fifth, and sixth tubes were i.f. amplifiers, while the seventh was the detector. It was used as an "anode bend detector" with an adjustable rheostat in the filament supply for controlling detection.

He reports that the noise level was such that it had to be a pretty strong signal to override the background noise.

Now, after 42 years in radio and radar in 47 countries, Mr. Baker is still going strong. Cheers, Mr. B! —30—

Certified Record Revue

(*Continued from page 62*)

now fully acclimated, and reaching the rapport that is so essential to a good performance. The RIAA curve was adequate and surfaces were quiet.

SAINT SAENS
CONCERTO #3 FOR VIOLIN AND ORCHESTRA
MENDELSSOHN
SONATA IN F
Yehudi Menuhin, violinist with Philharmonic Orchestra conducted by Gaston Poulet and Gerald Moore, pianist. His Master's Voice LHMV-1071. RIAA curve. Price $5.95.

An odd coupling this, but a very effective demonstration of the artistry of Yehudi Menuhin. The Saint Saens Concerto is the work of greater stature here and is afforded much better recording. I'm not positive, but I think this is the first *HMV* to be recorded with the new "Orthophonic technique." The results augur well for the future, as the sound of the Menuhin violin is a delight to the ear. One almost "re-discovers" the Menuhin talent, there is such a marked difference between this and previous recordings of this artist. Of the three other versions of this concerto available, only the Francescatti-*Columbia* offers any competition. This recording is a couple of notches better than it from both the sonic and performance viewpoints. While the *Columbia* sound was quite good for its day, it loses in comparison to the wider range, better dynamics and over-all cleanness of this disc. The Menuhin performance highlights the melodic aspects of the work, and his luminous, soaring tone is better suited than the "fire-breathing" of Francescatti. The Mendelssohn Sonata is well performed, but with sound recorded in 1952, is not as "live" as the Concerto. The jacket of this album gives some interesting notes about the recording and some good advice on adjusting your system for the RIAA curve. Moderately quiet surfaces.

STRAVINSKY
LES NOCES
MASS
PATER NOSTER
AVE MARIA
New York Concert Choir and New York Concert Orchestra with soloists conducted by Margaret Hillis. Vox PL8630. NARTB curve. Price $5.95.

At last we have the great "Les Noces" of Stravinsky in a decent recording! I say this because the only other recording (on the *Allegro* label) is a miserable caricature of the work. Poor sound and surfaces, and a pretty lackluster crew of artists didn't endear the work to many. Here we have the incomparable Margaret Hillis in charge of the proceedings and the result is what you might expect from her . . . a near perfect exposition of this brilliant score. "Les Noces" (The Wedding) marked a turning point for Stravinsky. In this work he eschews the mighty forces of "Le Sacre" and "Petrouchka" and delivers himself of yet another controversial masterpiece in a new and startling idiom. Utilizing folk themes of Russian peasant weddings as a basis, the work is scored for four pianos, percussion, mixed chorus, and solo quartet. While this may sound like very meager orchestration for Stravinsky, you must reckon with the manner in which the forces are employed. Much rhythmic use of the vocal elements in conjunction with the pianos and percussion, makes for a work of considerable dynamics. The complexity of the rhythmic patterns of voice and instrument is softened

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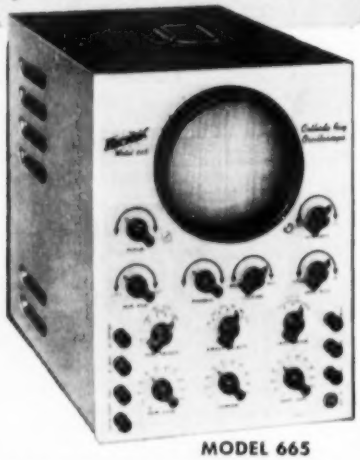

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by the text of the work, which is altogether delightful and amusing. Soundwise, this is a fine recording, one of the best things yet from *Vox*. The vocal parts are cleanly articulate the pianos have the proper percussive impact, necessary in this work, and the percussion itself is sharp and accurate. As with most Hillis-coached choruses, the vocalism is of very high order. No slurred accents here or ragged attacks! The individual soloists are quite good, and Adele Addison (soprano) should get an extra nod for her fine singing. As an added attraction on this disc is a performance of Stravinsky's "Mass" and "Two Motets," which sound better than the previous recording on *Victor*. All in all, a welcome disc which more than adequately fills a long-felt need. The NARTB curve was better with a couple of db bass boost. Quiet surfaces in my copy.

MARCHES BY SOUSA AND OTHERS
Eastman Symphonic Wind Ensemble conducted by Frederick Fennell. Mercury MG40007. RIAA curve. Price $5.95.

I have been looking forward to more recordings by Fennell and his remarkable group ever since their sensational debut last year. One of the things that a lot of people did quibble about in the initial recording was lack of familiarity with the works which comprised that disc. I don't happen to agree but those of you who thought this way will be pleased with the repertoire on this new disc. All the old standbys of Sousa are present, from "Fairest of the Fair" and "Manhattan Beach" to "Semper Fidelis." Other non-Sousa but equally familiar marches such as "National Emblem" are on the other side of the record. If you are looking for a "gassy," "oom-pah oomph" type of sound typical of high school and political bands, you won't find it here. This is a virtuoso group and the impact of their playing is tremendous. There is "oomph" all right . . . but not so much that the tonal values of the tuba can't be recognized. The sound is generally of even higher caliber than last year's notable disc. Brass is super-bright, super "weighty," woodwinds smooth and so clean that intonation is "individualized" and you can recognize players by the time you've heard the second or third number. Percussion is a hi-fi lover's dream come true! The bass drum gives forth with the appropriate, blam! blam! The snare is as sharp and accurate as a machine gun and the huge crashing cymbals set up a mighty din! When this band is going "all-out" on "Semper Fidelis," the effect is awesome! Another "lease-breaker" special. Better watch the db's on this one if you live in an apartment! The strong guiding hand of Mr. Fennell is much in evidence, a seeming necessity with this lucky group. This, surely, is one of the best representations of band music ever recorded. RIAA curve was OK without adjustment.

SCRIABIN
SONATA #4 FOR PIANO
HINDEMITH
SONATA #2 FOR PIANO
BERG
SONATA FOR PIANO (Op. 1)
BARTOK
SONATA FOR PIANO
Zadel Skolovsky, pianist. Columbia ML4871. NARTB curve. Price $5.95.

If this looks like a pretty formidable dose of modern music . . . you're 100% right. In fact, none but the most musically advanced will appreciate the record at all. For that group, however, this is a considerable bonanza. Each of these Sonatas is a masterpiece of writing for the piano, and represents a significant contribution from the works of the composers listed. Dissonance, atonality,

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and all the other familiar devices of "modernism" are present in these works, and it is to be admitted they will not be easy for the uninitiated to digest. Zadel Skolovsky has a particular flair for this sort of thing, and his playing has amazing technical facility. I've heard other versions of the Bartok Sonata that I like better from the standpoints of tempo and phrasing, but this, and the other works are blessed with splendid piano sound, beyond that afforded previous recordings. Recording is "close-to," piano generally percussive in tone, which is OK with this kind of repertoire. A slight wavering in the last part of the Scriabin, is the only blemish in an otherwise exemplary job of engineering. NARTB curve needed a slight treble cut before it sounded right in my set-up.

SIBELIUS
SYMPHONY #4
TAPIOLA
Philharmonia Orchestra conducted by Herbert von Karajan. Angel 35082. RIAA curve. Price $5.95.

I listen to so many recordings, I usually don't get a chance to sit down and repeat something I really like. Well, I *made* time for this one! While admitting that I am very fond of both of these works, I must credit my desire for a repeat to the excellence of interpretation and sound. This is a truly beautiful recording. The music has a sort of haunting melancholy that is quite out of the ordinary. Von Karajan as the conductor of these works, amazes me. To my knowledge he has not been noted for a special facility with Sibelius, yet I cannot recall when I have heard the "4th" or "Tapiola" so well performed. Von Karajan shows a healthy regard for tempi yet his reading is highly individualistic. He performs miracles in matter of balance and the Philharmonia responds magnificently to his every urging. The string tone here is fantastic. Utterly clean and edgeless, this is the way all strings should sound on records and rarely do. The same thing could be said for the woodwinds and the entire recording is favored with a "just right" liveness in the acoustic perspective. The "transparency" of the sound coupled with the strength and beauty of the music, make this an outstanding disc and it is highly recommended to you. The RIAA curve did not need adjustment. Very quiet surfaces.

BALLADS OF LONG AGO
Marais and Miranda, soloists, with the Pardo Ancient Instrument Ensemble. Columbia ML4894. NARTB curve. Price $5.95.

This is a most unusual disc and one worthy of your attention. Marais and Miranda are folk-singers of more than ordinary stripe, having invaded the world of the "pop" ballad and even TV in their careers. In combination with the Pardo ensemble, which uses such exotic instruments as pardessus de viole and the 14-stringed viole d'amour, they sing a group of utterly charming early ballads. Among the most delightful of these is "Chow Willy" an old English folk song which was the predecessor of the American, "Frog He Went A-Courtin'." This will charm any child from 6 to 60, believe me! The reproduction is first class, especially the mellow resonance of the old stringed instruments. The singing is characterized by clear, distinct enunciation, and it is quite evident that Marais and Miranda are masters of their art.

BARTOK
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PEACOCK VARIATIONS
Chicago Symphony Orchestra conducted by Antal Dorati. Mercury MG50038. RIAA curve. Price $5.95.

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Utrecht Symphony Paul Hupperts, Conducting

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Piano Concerto in E Flat, K 107
Artur Balsam, piano, Winterthur Symphony Orch., Otto Ackermann, Conducting

BACH
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A. Schreiner; Organ of the Tabernacle, Salt Lake City

WAGNER
Die Meistersinger, Prelude, Act 1,
Zurich Tonhalle Orch., Otto Ackermann, Conducting

DUKAS
Sorcerer's Apprentice,
Utrecht Symphony, Paul Hupperts, Conducting

MOUSSORGSKY
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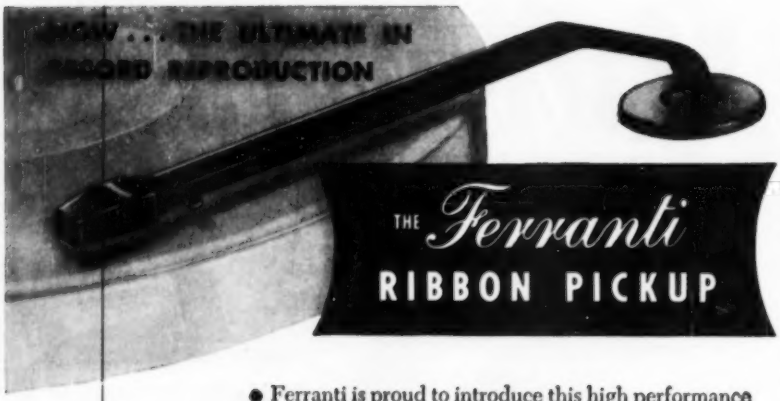

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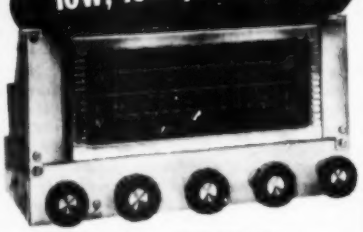

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stration piece for your system, it's terrific, and as a "test" of your wife's acceptance of "hi-fi," it's well nigh perfect. Brother, if you can slip the "Miraculous Mandarin" by her, your troubles are over. I think that almost any musicologist will agree that this Bartok score is just about one of the most frenetic things ever written. The whole thing, from blood-curdling background story, to the incredible scoring and orchestration, is an overwhelming listening experience. Peter Bartok recorded this work some time ago, and while that was an excellent version, this is far better both performance and soundwise. Antal Dorati studied under Bela Bartok and he brings his enthusiasm for his teacher's works to this recording. Guest conducting (and recording) with the Chicago Symphony, he drives the orchestra at a furious pace and the excitement generated is faithfully captured in the sound of this disc. From the frantic energy of the introduction to the utterly fantastic "chase" music of the finale, this record is a torrent of hi-fi super sound. Everything, but everything, in the orchestra cuts loose on this disc. Strings are used in their widest resource . . . pizzicato, stacatto, virtually the whole barrel of tricks. There is a huge organ counterpoint in the opening section, brass and woodwinds plumb the depths and soar stratospherically, percussion is omnipresent and used in dazzling variety. The dynamics on this disc are truly awesome. I don't think there is another work, save perhaps "Le Sacre," which has the great dynamic coloration present here. All this sound is superclean, ultra-wide-range and of terrific impact. The thundering tympani and shrieking, crashing brass of the finale will positively floor you! The "Peacock Variations" by Bartok's fellow countryman Zoltan Kodaly, is a highly colorful (and less athletic) work, enjoying its debut on LP. In a much quieter mood, this work is derived from an old Hungarian folk tune, "Fly, Peacock, Fly." Kodaly uses the theme from this as an opening theme to which he sets 16 variations and finale. In all of these variations he displays his great ability to write colorful material with an economy of orchestration. Sound is equal in quality to that on the "Mandarin." The Chicago Symphony plays very well under Dorati, probably enjoying the unusual repertoire. The wonderful acoustics of Orchestra Hall play their usual role in making this a highly successful recording. Don't let the explosive dissonance of the opening bars of the "Mandarin," throw you. Even if you don't care too much for modern music you'll enjoy this hi-fi *tour de force*. The RIAA curve was "just right."

DEBUSSY
LA MER
RAVEL
RAPSODIE ESPAGNOLE
Philharmonia Orchestra conducted by Herbert von Karajan. Angel 35081. RIAA curve. Price $5.95.

Some more surprises from von Karajan! With the expansion of this conductor into musical areas previously alien to him, we must recognize the great diversity of this man's talent. A formidable protagonist of Beethoven and Brahms, he seems equally at home with these two oft-recorded warhorses. The old question arises, of course, has this disc anything to offer over previous versions? Musically, we have the best performance of "La Mer" since the Toscanini. Karajan gives a more linear, less volatile reading than the Maestro, but his unhurried delineation of the score makes for considerable clarity. He has the advantage of a much more appropriate sound, a wide-range effort with exceptional string tone and "live" breathy woodwinds. Like much *Angel* sound, the clarity and cleanness coupled with the acoustics, make for sound, which for want of a better

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description I call "transparent." The "Rapsodie Espagnole" is given a vigorous, well integrated reading that compares favorably with the Ansermet-*London* version. Again sound is particularly good, with sharp, precise percussion in the "Feria" movement. Summing up, I would say that this is a more sensible coupling than the Toscanini disc, (which had Mendelssohn's "Midsummer Night" music) and with the superior sound represents a solid and satisfactory "buy." The RIAA curve needed a couple of db bass boost, to my ears. Quiet surfaces.

SAINT SAENS
CONCERTO #1 FOR CELLO AND ORCHESTRA
LALO
CONCERTO IN D MINOR FOR CELLO AND ORCHESTRA
Zara Nelsova, cellist, with London Philharmonic Orchestra conducted by Sir Adrian Boult. London LL964. RIAA curve. Price $5.95.

I have always admired the work of Zara Nelsova since her sensational "Schelomo," of some years back. An extraordinarily gifted cellist, she has the happy facility of being able to play the most technically difficult works without the pedantic and academic "dryness" common to some of her contemporaries. In this disc, the Saint Saens is the important work, and her reading is a fluent and beautiful thing. She has far more "heart" than the Leonard Rose-*Columbia* version, her closest competitor; and although the ancient Piatigorsky-*Victor* reading is magnificent in performance, the sound is so lackluster as to negate its importance. The sound here is magnificent, *London* even outdoing the great cello sound they produced in "Schelomo." Rich and darkly resonant, this is a treat on good wide-range systems. Sir Adrian and the London Philharmonic furnish a sympathetic accompaniment with bright clean sound. The Lalo is not too well known and previous recordings have been few and of no particular merit. I am not too familiar with the work, but from what I can hear, Nelsova does a better job than the others and the sound is magnificent. Hi-fi fans will find this recording useful for demonstrating quality in the 60-200 cycle range. The RIAA curve did not need adjustment.

GUITAR RECITAL
Luise Walker, guitarist. Epic LC3055. NARTB curve. Price $5.95.

This recording is distinguished mainly by the novelty of a "Concertino for Guitar and Orchestra" by Brazilian composer Guido Santorsola. This is performed by Walker and the Vienna Symphony under Paul Sacher. It seems to be a most interesting work, full of sections which require the virtuoso use of the guitar. Since I have never heard the work, I cannot comment upon the performance, but all the notes seem to be in the right place and it is obvious that the guitar playing is of the highest order. The rest of the disc is given over to some familiar and some not-too-well-known works for solo guitar, all of which seem expertly performed. The guitar sound is all you could want . . . good transients, gutty, richly resonant. This should be a fine disc for students of the instrument.

SHOSTAKOVICH
SYMPHONY #5 IN D MAJOR
St. Louis Symphony Orchestra conducted by Vladimir Golschmann. Capitol P8268. RIAA curve. $5.70.

It's nice to have a really good version of this work, but I wish the record companies would remember some of Shostakovich's other symphonies are due for modern recordings. This is the third version of the "5th" in recent months and would seem to take pretty good care of the work. We need new record-

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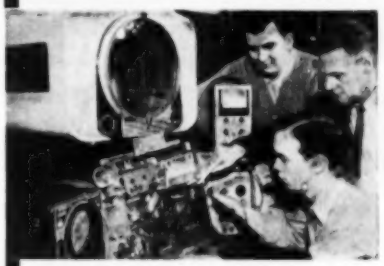

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ings of the "1st," "6th," and "9th" symphonies, and it is to be hoped someone will get around to recording the magnificent "8th" of Shostakovich, which is not represented at all on LP. Well now, having said my piece, I can report on this present version of the "5th." Golschmann's reading is not too "personalized." His tempi are fairly straightforward, except for a slower-than-usual finale. In spite of this, his is the most exciting reading now available, and it's most reminiscent of the old Rodzinski version. Mitropoulos and Horenstein are too fussy in their readings and lose the over-all drama of the work. Sound is very good on this disc, except for occasionally strident strings and thinness of tone. Bright, punchy brass and, for the first time, some decent percussion, especially in the important tympani. The St. Louis Symphony plays well under the deft direction of Golschmann, but the complexities of the finale are too much for a couple of boys in the brass section and they commit a few "flurps." Unless still more readings of this score are forthcoming, which is not too likely in view of the present number, this would seem to be a safe choice.

BACH, J. S.
CONCERTO FOR TWO HARPSICHORDS AND ORCHESTRA IN C MAJOR
CONCERTO FOR TWO HARPSICHORDS AND ORCHESTRA IN C MINOR
Finn Videro and Soren Sorensen, harpsichordists, with the Orchestra of the Collegium Musicum, Copenhagen, conducted by Lavard Friisholm. Haydn Society HSL93. NARTB curve. Price $5.95.

A notable first for the *Haydn Society* and a most welcome addition to the Bach catalogue is found in this recording. For those of you who think the harpsichord a "dry" and uninteresting instrument, I direct your attention to this disc. More gay and sparkling music would be hard to imagine. This recording is a perfect delight, with superb performances from the masterful Videro and the equally competent Sorensen. Some may think the harpsichord has been recorded a little too close at first listen, but actually it is well balanced with the orchestra and much detail comes through that is usually lost. The sound is wide range; excellent transients characterize the reproduction of the harpsichords, although reverb time causes a slight fusion at a few points in the score. The orchestral accompaniment is also distinguished by generally good sound. Beautiful music, good performance, sparkling sound . . . need I say more? NARTB curve was adequate without adjustment. Good surfaces.

BACH, J. S.
ORGAN RECITAL
Jeanne Demessieux playing the organ of Victoria Hall, Geneva. London LL946. RIAA curve. Price $5.95.

This is the record you people with the concrete horns and monster speaker systems have been dreaming about! Without the "phony" trumped-up bass of many organ recordings, this has some of the most fabulous pedal I've ever heard. *Really low* frequencies on this disc, in fact I would go so far as to say there are 16 cycle notes or at least their first harmonics! Three chorale preludes, the "Prelude in G Major" (a la Gigne), the "Prelude and Fugue in A Minor" and the famous "Toccata, Adagio and Fugue in C Major" constitute the selections on this disc. Jeanne Demessieux gives forceful, vigorous readings of these works and displays her fantastic technical agility. The "Toccata" is where you will find the really big pedals. Although the pedals come through magnificently, the recording is not unbalanced and the upper

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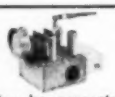

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register is clean and bright. If you have a good system which reproduces well below 50 cycles, you will be amazed at the way in which the pedals in the quiet sections of the work come through. When Miss Demessieux lets go with "full swell" on the big contra-bombarde pipes, the timbers start to shake! Really a remarkable recording.

VIVALDI
LA STRAVAGANZA
Reinhold Barchet, violinist, and Helma Elsner, harpsichordist, with Pro Musica String Orchestra, Stuttgart, conducted by Rolf Reinhardt. Vox DL103. NARTB curve. Price $17.85.

Here is an absolutely monumental recording. *Vox* has followed up its highly successful "L'Estro Armonico" of last year, with more Vivaldi from the same performers. This is certainly one of the most beautifully packaged albums in LP history. The album is leather-bound, stamped in gold and you are furnished with a 36-page book of program notes. This latter is lavishly illustrated and contains opening bars and thematic material from the score. Admittedly, not the kind of work you can sit down and digest all at once, but you find yourself wondering what the next concerto will sound like and before you know it, you're spinning another. Barchet is quite without peer in this sort of music and the tone of his violin is superbly appropriate. Reinhardt and the Pro Musica continue the good work they began in "L'Estro Armonico." Their ensemble work is a miracle of precision and balance. The sound is splendid. Clean, edgeless strings, yet strings that have bite and authority in the attacks. Add good acoustic perspective and you have a recording of the always interesting music of Vivaldi that deserves a place in every reference library and in the collection of every music lover who can afford it. The NARTB curve was "just right."

LISZT
TOTENTANZ
MENDELSSOHN
CAPRICCIO BRILLANT
RONDO BRILLANT
Peter Katin, pianist, with London Philharmonic Orchestra conducted by Jean Martinon. London LL1007. RIAA curve. Price $5.95.

The famous Liszt "Dance of Death" is the star attraction on this disc. And a bright star indeed! Boy, this is as rip-snortin' a version of this as you'll ever hear. Absolutely tremendous piano sounds, with the opening chords of the piano against the "Dies Irae" played fortissimo by full orchestra setting the eerie mood. Peter Katin is not too familiar a talent to me, but in this work he outguns all other competitors by a wide margin. He has great strength and technical facility, that overcomes a somewhat "hard" tone. However, it must be said that a hard tone is not too amiss in this fustian work. The combination of Katin's driving vitality and the superb sound make this recording a sure winner. The Mendelssohn works are interesting examples of his less important output, and receive equally good treatment from the hands of all concerned. An exciting recording, well worth your interest. The RIAA curve did not need adjustment. Moderately quiet surfaces.

TCHAIKOVSKY
PIANO CONCERTO #1
Geza Anda, pianist, with Philharmonia Orchestra conducted by Alceo Galliera. Angel 35083. RIAA curve. Price $5.95.

This is number 18, in the Tchaikovsky concerto sweepstakes. While a good one, I don't think we have found the winner yet. Geza Anda and the same forces that made the

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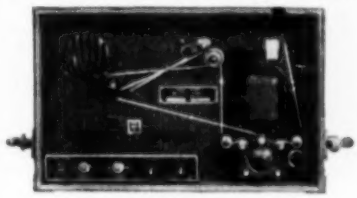

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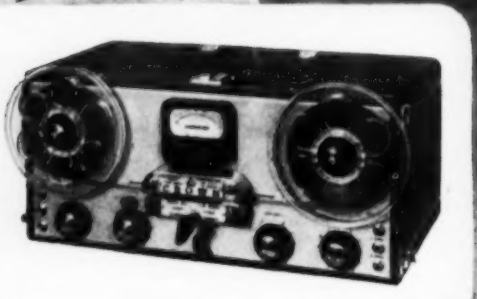

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recent Rachmaninoff "#2" so memorable, don't come off so well in this one. While Anda has lost none of his fluency and grace here, he detracts some from these qualities by over-fussiness in spots and by erratic tempi in other places. Still, if all things are considered, his reading is at least the equal of Brucholleric on *Vox* or Curzon on *London*. Add to this a generally better level of sound than the other discs and this is a recording which will find favor with many. Piano sound is clean, with no noticeable wow or flutter. String tone a little thin at times, good brass and percussion, good acoustics. RIAA curve needed a little bass boost.

TCHAIKOVSKY
AURORA'S WEDDING
Stokowski and his Symphony Orchestra. RCA Victor pre-recorded tape, 7½ ips, half-track. Price $14.95.

This is the forth and the best of the *Victor* tapes I have heard. I suspect that this is in a large measure due to Stokowski. He has always known how to get the best from an orchestra in recordings. Listen to some of his old recordings with the Philadelphia Orchestra on 78 rpm and you'll see what I mean. The music is one of Tchaikovsky's lesser known works, but is the sort of thing that lends itself admirably to hi-fi treatment. It gets full measure under Stokowski's expert direction. Strings are an aural delight, perfectly clean and edgeless. The brass is super bright, with none of the impact dulled as is so often the case when the transfer is made to disc. No resisting stylus or cutter is present to steal the thunder of the tympani, or dampen the shimmering high frequencies of cymbals. As with the other *Victor* tapes, there was no noticeable wow or flutter, signal-to-noise ratio was good, and total dynamic range seemed to be preserved. I do not know what tape equalization *RCA* uses, but the tapes sound good on both *Concertone* and *Magnecord* equipment, although it is necessary to turn down the treble a little when using the *Magnecord*. I'll let you know about *Ampex* as soon as I can, and will try a couple of the less expensive units as well. I might quibble with *Victor* to mark the title on the reels themselves. The leaders are quite well marked, but you know that leaders get torn off and tapes are not always in their boxes . . . result . . . you've got to play the tape to find out the title. A minor point, but it can be annoying. Otherwise, I have enjoyed these new tapes and will review some more of the first release next month. —30—

TV HINT

By ELMER C. FISCHER

SOME older sets with inadequate a.g.c. circuits tend to overload in close proximity to TV stations. If a weaker channel is to be received, an attenuator in the lead-in is obviously not the answer. Set owners seem to be reluctant to throw any switches or turn more knobs —it's got to be automatic!

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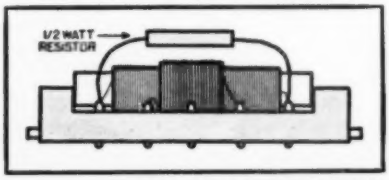

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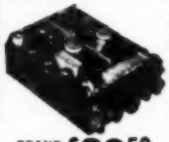

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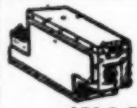

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DM-28	28V		224V	.07A.	2.25	4.95
PE-73	28V	20A.	1500V	.350A.	9.50	12.50

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Transistor Power Supply

(Continued from page 75)

mediately ready for use. Because of this, a "stand-by" switch is not needed.

Secondly, since a variable output voltage is provided, care should be taken to return the "Voltage Control" to its "zero setting" before turning the "Hi-Lo" switch from one position to the other. If the switch has been in the "Hi" position, in addition to turning the "Voltage Control" back, time should be allowed for the filter condensers to discharge to avoid damaging the voltmeter when the switch is thrown to the "Lo" position.

The filter condensers will discharge fairly rapidly where a load is connected to the output terminals, but more slowly (through the meter circuit) where the output terminals are "open." If a more rapid discharge is desired, a small bleeder resistor (20,000 to 50,000 ohms) may be connected across the output terminals.

Although designed primarily for use in transistor circuit development, the power supply described has many other possible applications in the electronics laboratory. The average experimenter or engineer will find that when such a supply is available, the number of possible applications tends to increase with time. While many such applications will be apparent, let us review a few.

A Bias Supply: Since the instrument delivers a d.c. voltage (at currents up to 50 ma.) that is *continuously* variable from 0 to over 100 volts, it is ideal for use as a bias supply when developing experimental transmitter circuits. In this application, the instrument is used in conjunction with a conventional "B" supply.

A Substitute "B" Battery Supply: The instrument is particularly valuable when developing portable, battery-operated equipment. The variable output voltage feature permits using the supply as a substitute for either a 15 v., a 22½ v., a 30 v., a 45 v., a 67½ v., or a 90 v. "B" battery. In addition, where the required current drain does not exceed 50 ma., the instrument may be used as a substitute "A" battery. If both "Hi" and "Lo" voltage output terminals are provided (instead of a single set of terminals and a selector switch), it may be used as an "A" and "B" battery substitute.

Meter Calibration Source: When used with a "standard" meter, the instrument is valuable for calibrating d.c. voltmeters and current meters. It is especially valuable in this application because the output voltage can be reduced right down to zero (many experimental power supplies have an output voltage that cannot be reduced below a given value). If the variable a.c. voltage feature is retained, the instrument may also be used for calibrating a.c. voltmeters or current meters. Again a "standard" meter should be used with the instrument. —30—

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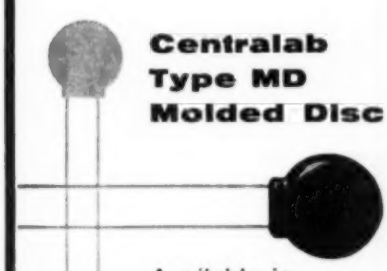

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Technical BOOKS

"HI-FI MANUAL" by Donald Carl Hoefler. Published by *Fawcett Publications, Inc.*, Greenwich, Conn. 144 pages. Price $0.75. Paper bound.

This little handbook for either the tyro or veteran audiophile contains much information of interest, written in simple, easy-to-understand language.

The author discusses sound and electronics, radio and records, turntables, reproducers, compensators and preamps, broadcast tuners, power amplifiers, speakers, enclosures and cabinets, tape recording, how to assemble a system, and includes a hi-fi directory, and glossary of terms.

Commercially-available equipment is used to illustrate the text and serve as examples in the author's discussion. As an over-all picture of the hi-fi field today, this little handbook would be hard to duplicate.

* * *

"HOW TO SERVICE TAPE RECORDERS" by C. A. Tuthill. Published by *John F. Rider Publisher, Inc.*, New York. 151 pages. Price $2.90. Paper bound.

The tremendous popularity of tape recorders offers a real bonanza to service technicians who understand such specialized circuitry and can handle this type of maintenance work.

This book is the practical answer to the problem of obtaining complete information on this specialized subject. The book itself is divided into six chapters, the first three of which cover the theoretical aspects of magnetic recording principles and applications. The fourth chapter deals with specific tape recording mechanisms while the fifth covers tape recording circuitry. The maintenance and repair of tape equipment is covered in the sixth chapter. A table which includes a cross-section of available commercial models is included in the appendix.

The use of numerous photographs, line drawings, and schematics helps to amplify the author's well-written and informative text material.

* * *

"THE OSCILLOSCOPE AT WORK" by A. Haas and R. W. Hallows. Published by *Iliffe & Sons, Ltd.*, London for *"Wireless World."* 167 pages. Price $3.25. Available in the U. S. from *The British Book Centre, Inc.*, 122 E. 55th, New York City.

This is a basic text on one of the most useful electronic tools available to the radio and television worker. A collaboration between M. Haas, author of the original French text, and R. W. Hallows of England, this book is encyclopaedic in its coverage of the scope.

The text has been largely rewritten by Mr. Hallows to conform to the currently-accepted British technique of oscillography. He has added a chapter dealing with the use of the scope for testing and aligning the 405-line (British standard) TV receiver.

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While some of the material is not applicable to equipment in use in this country, the fundamentals of oscilloscope operation and application hold true and provide a valuable reference for the reader.

Over 200 oscillograms as well as numerous circuit drawings and other diagrams add immeasurably to the acknowledged worth of this text.

* * *

"TV FIELD SERVICE MANUAL" edited by Harold Alsberg. Published by *John F. Rider Publisher, Inc.*, New York. 148 pages. Price $2.40. Paper bound. Vol. 2.

This manual covers *Bendix, Capehart, CBS-Columbia, Crosley,* and *Du Mont* television receivers released during the years 1947-1953. It is designed as a troubleshooting aid for the technician who must service receivers in the customer's home rather than the shop.

For each receiver model and chassis covered there is an individual listing of trouble symptoms (audio and video) as well as directions for their care. The troubles are described and illustrated pictorially in the form of test patterns. Under a section headed "Adjustments" the necessary information on how to make horizontal oscillator, tuner oscillator, picture tube, and a.g.c. adjustments is given. A tube list and top view layout charts are also provided.

The manual is spiral bound to open flat and pocket-sized to make it easier to take out on the service call.

* * *

"SPECIALIZED AUTO RADIO MANUAL" by the Rider Staff. Published by *John F. Rider Publisher, Inc.*, New York. 204 pages. Price $3.00. Paper bound. Vol. 5-A.

Here is another in the current *Rider* series of manuals for the technician specializing in audio radio servicing.

This volume covers receivers found in *Henry J, Hudson, Kaiser-Frazer, Nash, Packard, Studebaker,* and *Willys* cars for the years 1950-1954.

Like the previously-released manuals in this series, each receiver gets a complete analysis with a circuit diagram, alignment information, and troubleshooting data being included on each set. —30—

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ERRATUM

In the article "Simplified Design of Feedback Equalizers" (September 1954), the line just prior to equation (2) in the center column on page 35 should read R = ∞ (infinity). In some issues this line was incorrect or unreadable.

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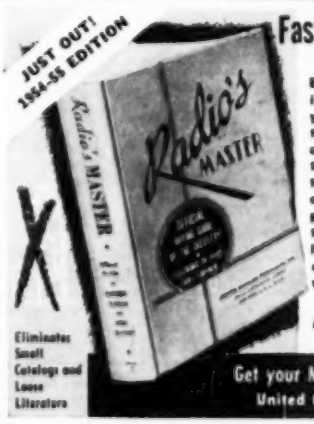

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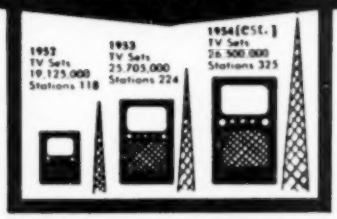

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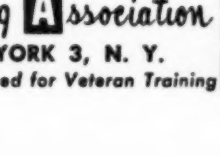

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NOVEMBER 1954

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OA2	.74	3E5	.46	**6BA7**	**.57**	6S8GT	.53	**7F7**	**.79**	12Q7	.59
OA4	.68	3LF4	.69	**6BC5**	**.54**	**6SA7GT**	**.55**	**7F8**	**.79**	12S8GT	.62
OB2	.81	**3Q4**	**.48**	6BD5	.59	6SD7GT	.41	7G7	.89	**12SA7GT**	**.65**
OC3	.72	**3Q5GT**	**.69**	**6BD6**	**.45**	6SF5GT	.46	**7H7**	**.59**	12SC7M	.63
OD3	.70	**3S4**	**.58**	**6BE6**	**.51**	6SG7GT	.41	7J7	.79	12SF5	.50
OZ4M	**.65**	**3V4**	**.58**	6BF5	.41	6SH7GT	.49	7K7	.69	12SG7	.51
1A5	.49	5AZ4	.59	6BF6	.37	6SJ7GT	.41	7L7	.59	12SJ7M	.67
1A7GT	**.47**	5T4	.79	**6BG6G**	**1.25**	**6SK7GT**	**.53**	**7N7**	**.69**	**12SK7GT**	**.63**
1AX2	**.62**	**5U4G**	**.55**	**6BH6**	**.53**	**6SL7GT**	**.48**	**7Q7**	**.66**	**12SL7GT**	**.57**
1B3GT	**.73**	5W4GT	.50	**6BJ6**	**.49**	**6SN7GT**	**.59**	7R7	.89	**12SN7GT**	**.52**
1C5	.43	**5Y3GT**	**.37**	6BK5	.80	**6SQ7GT**	**.46**	7S7	.79	**12SQ7GT**	**.56**
1E7	.29	5Y4	.51	6BK7	.80	6SR7GT	.45	7V7	.89	12SR7M	.49
1G6	.24	**5Z3**	**.45**	6BL7GT	.83	6SS7GT	.42	7X6	.54	**12V6GT**	**.46**
1H4	.30	6A6	.51	6BN6	.59	6T4	.99	7X7	.70	**12X4**	**.38**
1H5GT	**.49**	6A7	.69	**6BQ6GT**	**.98**	**6T8**	**.80**	**7Y4**	**.69**	14A4	.69
1L4	**.46**	6A8	.62	**6BQ7**	**.90**	6U5	.57	7Z4	.59	14A5	.59
1LA4	.59	**6AB4**	**.44**	**6BZ7**	**.90**	6U6	.59	12A6	.54	**14A7**	**.63**
1LA6	**.69**	6AC5	.69	**6C4**	**.40**	**6U8**	**.78**	12A8GT	.61	14AF7	.59
1LB4	.69	**6AC7M**	**.86**	**6C5**	**.39**	**6V6GT**	**.50**	12AL5	.37	**14B8**	**.63**
1LC5	.59	**6AF4**	**.90**	6C6	.58	**6W4GT**	**.47**	12AQ5	.52	14B8	.63
1LC6	.79	**6AG5**	**.56**	**6CB6**	**.54**	**6W6GT**	**.57**	**12AT6**	**.41**	14C5	.79
1LD5	.59	**6AG7M**	**.99**	**6CD6**	**1.11**	**6X4**	**.37**	**12AT7**	**.72**	14C7	**.79**
1LE3	.59	**6AH4**	**.57**	6CF6	.64	**6X5GT**	**.37**	**12AU6**	**.46**	14E6	.75
1LG5	.69	**6AH6**	**.73**	6CS6	.51	**6X8**	**.75**	**12AU7**	**.60**	14E7	.88
1LH4	**.69**	6AJ5	.65	6D6	.59	6Y6G	.48	**12AV6**	**.39**	14F7	.65
1LN5	**.59**	**6AK5**	**.55**	**6E5**	**.48**	7A4	.47	**12AV7**	**.73**	14F8	.69
1N5GT	**.67**	**6AK6**	**.59**	6F5GT	.39	7A5	.59	12AX4	.67	14H7	.59
1P5GT	.57	**6AL5**	**.42**	6F6	.59	7A6	.69	**12AX7**	**.63**	14J7	.30
1Q5GT	.58	**6AM8**	**.78**	6G6	.42	**7A7**	**.69**	12AY7	.69	14N7	.84
1R5	**.62**	**6AQ5**	**.50**	**6H6GT**	**.41**	**7A8**	**.68**	12AZ7	.59	**14R7**	**.79**
1S4	.59	**6AQ6**	**.37**	**6J5GT**	**.43**	7AD7	.79	12B4	.60	14S7	.89
1S5	**.51**	**6AQ7**	**.70**	**6J6**	**.52**	7AF7	.53	**12BA6**	**.49**	14W7	.30
1T4	**.58**	**6AR5**	**.45**	6J7	.40	7AG7	.69	12BA7	.60	14X7	.69
1T5	.59	**6AS5**	**.50**	6K5	.47	7AH7	.79	12BD6	.45	14Y7	.62
1U4	**.57**	**6AS6**	**1.49**	**6K6GT**	**.45**	7B4	.44	**12BE6**	**.51**	19BG6	1.39
1U5	**.50**	**6AT6**	**.41**	6K7	.44	7B5	.45	12BF6	.39	**19T8**	**.69**
1V	.43	**6AU4GT**	**.68**	**6L6**	**.84**	7B6	.69	**12BH7**	**.63**	19V8	.79
1X2A	**.63**	**6AU5GT**	**.82**	6L7M	.68	**7B7**	**.49**	**12BY7**	**.65**	24A	.39
2A3	.30	**6AU6**	**.46**	6N7M	.63	7C4	.59	12BZ7	.65	**25AV5GT**	**.83**
2W3	.38	6AV5GT	.83	**6Q7**	**.45**	**7C5**	**.69**	12C8M	.34	**25BQ6GT**	**.98**
2X2	.49	**6AV6**	**.40**	6R7	.69	**7C6**	**.59**	12H6	.56	**25L6GT**	**.51**
3A4	.45	**6AX4GT**	**.65**	**6S4**	**.48**	7E5	.59	12J5	.42	25W4GT	.59
3B7	.27	6B4	.54	6S7M	.79	7E6	.30	12J7	.49	**25Z5**	**.66**
3D6	.27	**6BA6**	**.49**	6S78	1.90	7E7	.59	12K8	.59	25Z6	.49

Type	Price
26	.45
27	.39
32L7	.89
35	.58
35A5	.58
35B5	**.52**
35C5	**.51**
35L6GT	**.51**
35W4	**.47**
35Y4	**.54**
35Z3	**.59**
35Z4	.47
35Z5GT	**.47**
36	.39
45	.55
45Z5	.49
46	.69
50A5	**.55**
50B5	**.52**
50C5	**.51**
50L6GT	**.61**
50X6	.49
50Y6	.49
50Y7	.50
55	.49
56	.49
57	.58
58	.60
70L7	.97
75	.49
76	.44
77	.57
78	.47
80	.43
83V	.68
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85	.59
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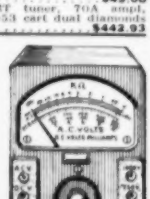

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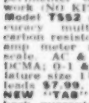

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up to 28VDC at 12 amps	29.98
up to 28 VDC at 24 amps	63.98
up to 28VDC at 50 amps	87.00

NEW RECTIFIER CHOKES

CH07/4 Amp/.07HY/.6RES/10Ω . . . **$7.95**
CH01/12 Amp/.01HY/.1RES/2Ω . . . **$9.95**
CH004/24 Amp/.004HY/.025R/20Ω . . **29.95**

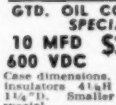
MIKES & HEADSETS

Crystal Mike Cartridge
Ea. **$1.25; 3 for $3.00**
Crystal Mike & Cable
Ea. **$2.50; 3 for $6.00**
Navy Mike Carbon . . . $1.98
P-20 Headset High Imped. 24,000/ohm. **$4.98**
T30V Throat Mike Dble Button 200-5000 Cps. 85¢; **6 $4**
Sound Powered Headset. Chest Mike & Throat Mike. U. S. Navy. . . $15.98; 2 $30

NEW 230 TO 115V AUTOFORMERS

For 220-240V/50-60 cy input. To 110-120V or step-up. With cord, Plug & Receptacle.
TPA600 500W **$2.95**; **TPA750** 750W **$3.55**
TPA100 /100W **$4.00**; **TPA200** 200W **5.75**
TPA250 250W **$6.75**; **TPA300** 300W **7.25**
TPA500 500W **$8.25**; **TPA750** 750W **11.75**
TPA1000 1000 W 1KW . . . **$16.95; 2 $32**
TPA1500 1500W 1.5KW . . . **$22.50; 2 $42**
TPA2000 2000W 2KW . . . **$28.95; 2 $54**
TPA3000 3000W 3KW . . . **$49.95; 2 $93**

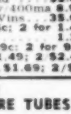
TRANSFORMERS



ALL 115V 60CYC INPUTS
2500V/200MA, 6.3V/6A, 2.5V 1.75A, 4/8C412 Scope . **$7.98**
1600VCT/5MA, 6.3VCT/3A, 6.3VCT/10A, 2.5VCT/6A . **$7.95**
700VCT/100MA, 5V/2.5A, 5V/5A, 45V/1A, 10V/1.5A . **$4.98; 3 for $13**
900V/35MA, 2x2.5V/2A Xclent 1800V Dblr. TWO 2X2 FIL WNDGS . . . **$1.98**
775VCT 200MA, 5V/3A, 6.3VCT/5A THORDARSON . **$4.98; 2 for $9; 6 for $24**
770V 2.5MA, 2.5V/3A, HMSLD FILTER PARTS 4 scope . . . **$3.69; 2 for $6.00**
700VCT 70MA, 5VCT/3A, 6.3VCT/3A **$3.98**
600VCT 50MA, 6V 3A, 6V 1.5A, 5V 1A HALF SHELL **$2.49; 2 for $4.50; 10 for $20**
350VCT 250MA, 5V/2A, 6.3VCT 2.5A, 5 V/3.5A, RCA CSD . . . **$4.50; 2 $8**
500VCT 60MA, 6.3V 4A HMSLD . . . **$2.98**
420VCT 90MA, 6.3V/1.5A, W INPUTS @ 12, 24, 115VDC à 115 & 230 VAC @ . . . **$1.49**
2X330VCT.10MA Each Winding **$1.39**

GTD. OIL CONDENSER SPECIAL

10 MFD $1.75 ea.
600 VDC lots of 3



Case dimensions, not including insulators 41⁄4H x 3¾W x 1¼"D. Smaller Quantities, special **$1.98**

FILAMENT TRANS.

2.5VCT/10A 12.5KVINS. . **$5.50; 3 for $14**
2.5VCT/10A 5KVINS. **$3.59**
7.5VCT 12A 15 KVINS **10.95; 2 for $17.50**
24V 1.25A CSD. . . . **$1.98; 2 for $3.50**
42.5V 2A Sel Reet Xfmr . . . **$4.98; 2 $8**
64V 1 Amp HMSLD . . . **$3.49; 2 for $5.00**
PRI 110 & 220V Sec 16.6V/1.25A, 12.6 VCT/3.5A **$4.98; 2 $8.00**

FILTER CHOKES

Check These Reduced Prices
50Hy/125ma/Csd H'std **$2.89**
20Hy/300ma or 15.Hy/400ma **$3.98**
13.5 Hy 1 Amp./17KVins. . . . **35.00**
Dual 2Hy/300ma. USN. . . . 98c; **2 for 1.49**
10Hy 100 MA Pyrex **$1.98**
30Hy 40ma UTC HI "Q" . . . 69c; **2 for 98c**
6Hy 175MA. **$1.49; 2 $2.49**
2.5 Hy 30ma MA 60 Ohm. . . . . **$1.69; 2/$3**

RCA Licensed ONE YEAR GTD PICTURE TUBES

Tube Type	Dud Return	No Dud
10"	$10.00	$12.00
12"	12.00	14.50
14"	14.00	16.50
16"	16.00	19.00
17"	17.00	20.00
19"	19.00	22.25
20"	20.00	23.50
21"	21.00	24.50

IMPORTANT! Ship your old tube with order prepaid only. If you return your old tube, use Dud return prices. All prices F.O.B., N.Y.C. Add shipping charges.

SENSATIONAL SLIM-JIM HIGAIN DYNAMIC MIKE & TILT STAND

Hand, chest or table use. Compact, weight only 7 ozs. W.F. Head: UTC-XFMR 4/8/16M, mobile, PA and recording . . . —50HR/80-7500 CPS.

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Mobile Clamp. . . . 25¢

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PRICES SUBJECT TO CHANGE
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0A2	$0.88	3D22	13.07	6SQ7GT	.62	81	1.38	829	7.94
0A3 /VR75	1.04	3D23	4.90	6SR7	.62	83	1.12	829B	12.48
0B2	3.38	3E29	14.49	6SS7	.62	83V	.62	832	7.72
0B3 /VR90	.96	4C35	21.49	6SU7GTY	2.69	84 /6Z4	.62	832A	9.02
0C3 /VR105	.92	4D21	18.99	6T8	.96	100TH	9.48	833A	39.45
0D3 /VR150	.98	4E27	18.99	6U5	.74	117L6GT	1.98	836	5.95
1B3 .8016	.80	4J22	129.51	6U8	.99	117L7	M7GT	1.98	837	5.95
1B22	1.82	4J31	99.51	6V6	1.39	M7GT	1.98	837	.42
1B24	1.82	4J32	99.51	6V6GT	.59	117Z6GT	.98	849	25.41
1B26	8.98	EL5BND	15.99	6W4GT	.52	CV148	9.98	860	4.48
1B29	2.24	5C21 /C6J	9.89	6X5GT	.54	FG166	48.49	861	22.48
1B27	11.22	5C22	39.95	6Y6G	.54	FG172	48.49	872A	1.50
1B32 /532A	2.48	5D21	14.98	7A8	.68	250TH	18.97	866A	1.50
1B35	9.15	5J20	11.92	7C7	.76	250TL	17.75	872A	3.29
1B37	14.98	5R4GY	1.79	7E7	.76	304TH	19.48	1616	.62
1B38	29.45	5R4GYW	1.79	7F8	1.24	304TL	12.49	1613	.82
1B41	49.95	5U4	.65	7H7	.72	1B8A	1.48	1614	1.95
1B42	1.98	5U4G	.55	7N7	.68	4-65A	8.48	1619	.82
1B43	1.98	5Z3	.99	7V7	.74	4-125A	8.48	1625	.52
1B61	45.00	6AQ5	.71	7Y4	.68	5842	18.50	1632	.68
1B23 SN4.	1.89	6AK5	1.14	10DE1	298	GL-434A	2.98	1634	1.14
1L4	48	6AN6	1.21	12AG	48	446B	3.48	1634	1.14
1L6	1.35	6AJ5	1.40	12AH7GT	1.45	450TH	49.97	1635	1.69
1LD5	.98	6AK6	1.14	12AL5	52.00	450TL	52.00	1637	1.74
1LN5	.78	6AK6	.92	12AT6	.54	460		1642	.82
1R4	1.29	6AL5	.48	12AT7	.69	HF200	15.95	1644	.92
1S4	.59	6AM6	.52	12AU6	.49	CK503AX	1.49	2050	1.49
1U4	.52	6AN5	3.27	12AV6	.52	CK505AX	1.79	2050W	2.48
1U5	.54	6AQ5	.82	12AV7	.81	CK512AX	1.49	5654	1.72
1X2A	.98	6AQ7GT	.81	12AW6	1.18	CK531DX	1.89	5670	1.72
2A4G	1.18	6AQ7GT	1.29	12AX7	.98	931	9.72	CK5672	1.20
2C36	27.00	6AR6	3.27	12BA6	.54	1B32DX	3.98	CK5678	1.28
2C39A	25.98	6AT6	3.48	12BA7	.59	WL531A	3.48	6683	1.74
2C40	4.98	6AT6	.54	12BA6	.59	WL532A	3.48	CK5702	2.90
2C43	17.48	6AU6GT	1.10	12BA7	.59	CK533AX	1.29	CK5703	2.29
2C51	3.88	6AV5GT	.98	12BD6	.59	CK538DX	.99	5712	120.00
2C51	3.88	6AV6GT	.98	12BE6	.59	CK538DX	3.19	5812	2.99
2D21	1.18	6AV6	.49	12BF6	.59	CK539DX	3.19	5814	2.08
2E43	1.49	6BA6	1.09	12BH7	.69	CK540DX	1.89	5879	7.98
2E43	1.49	6BA6	1.18	12SA7GT	.58	CK543DX	.99	6012	2.58
2J51	37.00	6BA6	.84	12SC7	1.08	CK544DX	.99	6013A	3.92
2J52	37.00	6BC5	.82	12SF7GT	.58	CK545AX	1.99	6021A	4.64
2J53	37.00	6BC5	.63	12SG7	.80	CK571AX	.99	9001	1.12
2J54	24.98	6BC7	1.23	12SH7	.63	5886	2.49	9002	.82
2J55	24.98	6BE6	.81	12SJ7	.46	CK5787AX/ 6029	3.49	9003	1.12
2J56	69.98	6BF6	.98	12SK7	.62	WL578	34.98		
2J39	8.98	6BF6	.98	12SL7GT	.62	WL579	34.98	XTAL DIODES	
2J48	149.50	6BG6GB	1.58	12SN7GT	.54	708A	1.98		
2J49	84.00	6BH6	.63	12SQ7GT	.54	709A	1.98	1N21A	1.55
2J60	84.00	6BJ6	.98	12SR7	.86	707A	7.90	1N21B	2.10
2J61	84.00	6BK7A	1.58	12U7	.54	715A	4.98	1N22	1.22
2J51	238.98	6BL7GT	1.19	24G 3C24	1.32	715A	4.98	1N23	1.35
2J58	84.98	6BN7	2.69	25B06GT	.98	715B	7.94	1N23A	1.35
2J59	149.50	6BQ6GT	1.20	25L6GT	.87	715C	17.98	1N23B	1.89
2J63	49.45	6BQ7	1.69	25Z5	.78	717A	.88	1N23B	2.00
2K22	37.48	6C21	24.50	26Z6GT	.58	719A	24.48	1N25	4.98
2K23	11.48	6C4	.52	FG27A	8.48	721A	3.69	1N26	8.75
2K25	28.49	6C8	.88	28D7	1.94	722A 267	1.94	1N27	1.85
2K25/ 7580WA	21.88	6C86	.88	35B5	.52	723A B	16.98	1N34	.64
2K28	27.48	6D4	2.70	35C5	.52	724B	4.98	1N34A	.88
2K29	22.88	6DQ6B	1.98	35T	4.98	724B	2.74	1N35	.64
2K32	49.95	C6J /5C21	9.89	35Y4	.68	725A	9.98	1N38A	1.29
2K39	134.99	6J5	.54	35Z3	.72	726A	44.88	1N41	8.95
2K39	134.99	6J6	.54	41	.72	726B	44.88	1N42	8.95
2K41	126.00	6J6	.59	43	.68	726C	64.88	1N48	1.48
2K48	99.48	6J6A	3.27	45Z3	.68	727A		1N48	.69
2K2	42	6L6	.48	48	1.98	803	3.48	1N48	4.00
1B23	2.48	6L6G	1.08	50A5	.76	805	3.22	1N48	.47
1B23 RK32	2.48	6L6GA	1.08	50B5	.76	807	1.98	1N51	.43
1B24	4.70	6L6GAY	1.08	50C5	.54	808	2.62	1N54	.78
1B25	4.38	6SA7GT	.66	50L6GT	.62	809	3.58	1N54A	1.00
1B26	7.90	6SC7	.68	RK61		810	11.98	1N58A	1.15
1B28	7.90	6SF5	.78	XFG1	2.65	811	2.70	1N60	.65
3C22	98.00	6SG7	.84	FG67	14.68	812	3.70	1N63 /K63	2.49
3C24	1.98	6SH7	.84	FG81A	14.68	813	11.98	1N64	.69
3C31 /C1B	3.45	6SJ7	.58	T1A	4.98	814	4.98	1N65	.69
3C33	6.51	6SK7GT	.56	7B	4.98	815	5.98	1N66	.69
3C45	9.98	6SL7GT	.86	7C	4.98	826	2.98	Other Types in Stock. Write.	
3D21A	8.15	6SN7GT	.68	80	58	828	9.38		

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Now offers a completely new line of antennas, designed to solve your reception problems regardless of location . . . Each antenna has been designed both electrically and mechanically to provide you with the finest in reception and lasting durability. All aluminum in construction —all elements doubly reinforced at the stress points and braced to the boom with the new VEE-D-X "triad lock" hardware—for positive durability.

Try the VEE-D-X antenna of your choice. Prove to yourself that VEE-D-X offers the finest in performance and construction at NO EXTRA COST.

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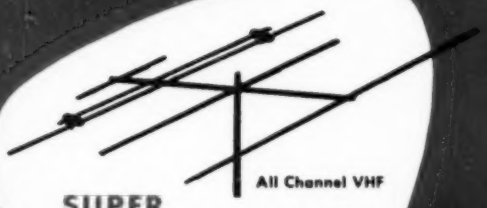


All Channel VHF

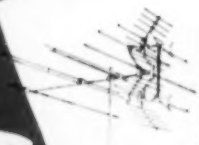
SUPER Q-TEE

Power packed "Big Brother" of the Q-Tee, with a new floating reflector for maximum performance over the entire VHF band. Can be stacked for greater gain . . . compact . . . neat rooftop appearance.

Model SP11

SHARP-SHOOTER

All channel VHF antenna for fringe and difficult signal areas. Incorporates yagi-power and directivity for exceptionally high gain over the VHF band. Extraordinary front-to-back ratio eliminates ghost and interference problems.



SUPER CHIEF

With "Dyna-phase" The first antenna with extremely high gain over the entire VHF-UHF band with excellent directivity—high front-to-back ratio—all with a single transmission line. Neat in appearance—all aluminum in construction. The Super Chief is completely pre-assembled.

	LIST
Super Q-TEE	$10.95
Chief	19.95
Sharp Shooter (SP11)	24.75

★

These antennas are ideal for use with the completely new VEE-D-X rotator. Smart in appearance—redesigned for lasting durability and trouble-free operation at the new low cost.

Remember . . . all channel reception in your area at fingertip control with only one antenna on your rooftop. Install the VEE-D-X antenna of your choice with the VEE-D-X rotator for trouble-free reception NOW and in the future.

NEW... IMPROVED ROTATOR

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- Self-control, flanged spur gear train—slipped reinforced gear teeth cannot be stripped.
- Full 355 degree traverse
- Built in thrust bearing
- Super-strength double reinforced case
- Double guy rings for right mast connections
- New anti-shorting terminal board
- Completely sealed rotor housing for dust protection
- New potentiometer
- Positive brakeshoe on motor
- Non-bind screws for easy installation
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- Positive connection terminals
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The finest in design, construction and performance. Clean-cut inline construction. Fast and easy to install.

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Mallory . . . and only Mallory . . . offers you both types of ALL-CHANNEL UHF CONVERTERS—one designed to fit inside any TV set and the other to be used on or beside any set.

The New Mallory '188' Concealed Converter is mounted inside the TV set . . . out of sight! All that shows is a clear plastic selector dial and switch. Installation is easy. A bracket and four screws are supplied to mount the unit on either side or at the top in wood cabinets. For plastic or metal cabinets, the converter may be mounted on the fiber-board rear enclosure.

Both the Mallory '188' and the Mallory '88' Cabinet Model give the same trouble-free performance, that has made Mallory the leading converter in every area since the start of UHF telecasting.

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